for Machine Tools –

Safety Requirements for Power Press Brakes

ANSI B11.3 – 2002

Designation		Approved American National Standards
ANSI–		
B11.1–2001		***Safety Requirements for Mechanical Power Presses***
B11.2–1995	**(R2000)***	***Hydraulic Power Presses – Safety Requirements for Construction, Care and Use***
B11.3–2002		***Safety Requirements for Power Press Brakes***
B11.4–1993		***Shears – Safety Requirements for Construction, Care and Use***
B11.5–1988	**(R1994)***	***Iron Workers – Safety Requirements for Construction, Care and Use***
B11.6–2001		***Safety Requirements for Manual Turning Machines with or without Automatic Control***
B11.7–1995	**(R2000)***	***Cold Headers and Cold Formers – Safety Requirements for Construction, Care and Use***
B11.8–2001		***Safety Requirements for Drilling, Milling, and Boring Machines***
B11.9–1975	**(R1997)***	***Grinding Machines – Safety Requirements for Construction, Care and Use***
B11.10–1990	**(R1998)***	***Metal Sawing Machines – Safety Requirements for Construction, Care and Use***
B11.11–2001		***Safety Requirements for Gear & Spline Cutting Machines***
B11.12–1996		***Roll Forming and Roll Bending Machines – Safety Requirements for Construction, Care and Use***
B11.13–1992	**(R1998)***	***Single- and Multiple-Spindle Automatic Screw/Bar and Chucking Machines – Safety Requirements for Construction, Care and Use***
B11.14–1996		***Coil Slitting Machines/Systems – Safety Requirements for Construction, Care and Use***
B11.15–2001		***Safety Requirements for Pipe, Tube, and Shape Bending Machines***
B11.16–1988		*Metal Powder Compacting Presses – Safety Requirements for Construction, Care and Use* **(WITHDRAWN)**
B11.17–1996		***Horizontal Hydraulic Extrusion Presses – Safety Requirements for Construction, Care and Use***
B11.18–1997		***Machinery and Machine Systems for the Processing of Strip, Sheet, or Plate from Coiled Configurations – Safety Requirements for Construction, Care and Use***
B11.19–1990	**(R1997)***	***Performance Criteria for the Design, Construction, Care and Operation of Safeguarding when Referenced by the other B11 Machine Safety Standards***
B11.20–1991	**(R1997)***	***Manufacturing Systems/Cells – Safety Requirements for Construction, Care and Use***
B11.21–1997		***Machine Tools Using Lasers for Processing Materials – Safety Requirements for Construction, Care and Use***
ANSI–		**Registered Technical Reports**
B11.TR1–1993		***Ergonomic Guidelines for the Design, Installation and Use of Machine Tools***
B11.TR2–1997		***Mist Control Considerations for the Design, Installation and Use of Machine Tools Using MetalWorking Fluids***
B11.TR3–2000		***Risk Assessment and Risk Reduction – A Guide to Estimate, Evaluate and Reduce Risks Associated With Machine Tools***

* = Standard that has been reaffirmed by the ANSI B11 Accredited Standards Committee, and the year of reaffirmation. The date next to the standard designation is its last revision.

For pricing and availability of the standards and technical reports listed above, go to WWW.AMTONLINE.ORG and search on "B11"

ANSI B11.3

American National Standard for Machine Tools –

Safety Requirements for Power Press Brakes

Secretariat and Accredited Standards Developer:

The Association For Manufacturing Technology
Attn.: Safety Department
7901 Westpark Drive
McLean, VA 22102

Approved: FEBRUARY 14, 2002

by the American National Standards Institute, Inc.

American National Standard

Approval of an American National Standard requires verification by ANSI that the requirements for due process, consensus, and other criteria for approval have been met by the standards developing organization.

Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made toward their resolution.

American National Standards are promulgated through ANSI for voluntary use; their existence does not in any respect preclude anyone, whether they have approved the standards or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standards. However, users, distributors, regulatory bodies, certification agencies and others concerned may apply American National Standards as mandatory requirements in commerce and industry.

The American National Standards Institute does not develop standards and will in no circumstances give an interpretation of an American National Standard. Moreover, no person shall have the right or authority to issue an interpretation of an American National Standard in the name of the American National Standards Institute. Requests for interpretations should be addressed to the Secretariat whose name appears on the title page of this standard.

CAUTION NOTICE: This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken periodically to reaffirm, revise, or withdraw this standard. You may contact the Secretariat for current status information on this, or other B11 sister standards. Individuals interested in obtaining up-to-date information on standards can access this information at **http://www.nssn.org** (or by contacting ANSI). NSSN – A National Resource for Global Standards, provides a central point to search for standards information from worldwide sources and can connect those who seek standards to those who supply them.

AMT makes no warranty, either expressed or implied as to the fitness of merchantability or accuracy of the information contained within this standard. Unless it can be shown that AMT or the standards writers of this standard acted with deliberate bad faith or malicious intent, neither AMT, the standards writers or the standards writers' employers are liable for damages or injuries as a result of conformance to this standard.

Published by

AMT – The Association For Manufacturing Technology
7901 Westpark Drive, McLean, VA 22102–4269, USA

Printed in the United States of America

Table of Contents Page

Foreword (This Foreword is not part of the requirements of American National Standard B11.3-2002)

The primary objective of this standard is to eliminate or control hazards to individuals associated with press brakes by establishing requirements for the design, construction, operation and maintenance of these machines. To accomplish this objective, responsibilities have been assigned to the supplier (e.g., manufacturer, rebuilder, reconstructor, installer, integrator), the user, and individuals in the working environment.

The words "safe" and "safety" are not absolutes. Safety begins with good design. While the goal of this standard is to eliminate injuries, this standard recognizes that risk factors cannot be practically reduced to zero in any human activity. This standard is not intended to replace good judgment and personal responsibility. Operator skill, attitude, training, job monotony, fatigue and experience are safety factors that must be considered by the user.

Press brakes and associated equipment technologies are continuously evolving. This standard is reflective of the most commonly used and time-tested state of the art at the time of its approval. The inclusion or omission of language relative to any evolving technology, either in the requirements or explanatory area of this standard, in no way infers acceptance or rejection of such technologies.

Inquiries with respect to the application or the substantive requirements of this standard, and suggestions for its improvement, are welcomed and should be sent to the AMT – The Association For Manufacturing Technology, 7901 Westpark Drive, McLean, Virginia 22102-4269, Attention: B11 Secretariat.

This standard was processed and submitted for ANSI approval by the B11 Accredited Standards Committee on Safety Standards for Machine Tools. Committee approval of this standard does not necessarily imply that all committee members voted for its approval. At the time this standard was approved as an American National Standard, the ANSI B11 Accredited Standards Committee was composed of the following member organizations:

John W. Russell, PE, CSP Chairman
Gary D. Kopps, Vice-Chairman
David A. Felinski, Secretary

Organizations Represented	***Name of Representative(s)***	
	Delegate	***Alternate***
Aerospace Industries Association of America	Will Wood, ARM	Robert Eaker
Alliance of American Insurers	John Russell, PE, CSP (D)	Keith Lessner
Aluminum Extruders Council	Jeff Dziki	Martin Bidwell
American Institute of Steel Construction	Thomas Schlafly	
American Society of Safety Engineers	Bruce Main, PE, CSP	George Karosas, PE, CSP
Association For Manufacturing Technology	Russell Bensman	
Can Manufacturers Institute	Geoff Cullen	
Deere and Company	Gary D. Kopps	Ellen K. Blanshan
Forging Industry Association	John W. Commet	Karen Taylor
General Motors Corporation	Michael Taubitz	
Graphic & Product Identification Mfgs. Assn.	Donald Root	
International Association of Machinists & Aerospace Workers, District Lodge 142	Jim Soptic	Ken Hass

Intl. Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW)	Jim Howe, CSP	Luiz Vazquez
Machinery Dealers National Association	John Stencel, III	James Heppner, Jr.
Metal Building Manufacturers Association	Charles M. Stockinger	Charles E. Praeger
Metal Powder Industries Federation	Dennis Cloutier, CSP	Donald White
National Electrical Manufacturers Association	Vincent A. Baclawski	Frank Kitzantides
National Fluid Power Association	June VanPinsker	
National Tooling and Machining Association	Andy Levine	Richard R. Walker
Precision Metalforming Association	Christopher E. Howell	Christie Carmigiano
Presence Sensing Device Manufacturers	Jim Kirton	Barry Stockton
Rubber Manufacturers Association	Kim Weber	Robert Walker
Sheet Metal and Air Conditioning Contractors' National Association	Thomas Soles	Tom J. Meighen
Steel Service Center Institute	Bob Carragher	Nicole LaPorte
Tooling and Manufacturing Association	Jeffery W. Hayes	Bruce C. Braker
Unified Abrasives Manufacturers' Association, Bonded Division	Charles S. Conant	
U.S. Department of the Navy (NAVSEA)	William Hanna	William Thacker

At the time this standard was approved, the ANSI B11 ASC **B11.3 Subcommittee** had the following members who participated in the development of this revision:

James V. Kirton, Chairman
David A. Felinski, Secretary

Dean Albrecht	Halkin Tool Ltd.
Peter Barroso	Barroso Engineering, Inc.
Samuel Boytor	Fox Controls, Inc.
Michael S. Carlson	Banner Engineering
Dennis Cloutier	Cincinnati, Inc.
Paul Cyr	U.S. Department of Labor-OSHA
Howard DeWees	SICK, Inc.
Dennis R. Ebens	Rockford Systems Inc.
Hugh Ettefagh	Amada Engineering & Service
George Fargher	Tapeswitch Corp.
Donald R. Humbert	Cincinnati Inc.
Thomas J. Meighen	SMACNA, Inc.
John Perotti	Gordon Engineering Corp.
George Rawlinson, PE	Rawlinson & Associates, Inc.
William S. Roorda, PE	Alcona Associates
George Schreck	Komatsu America Industries Corp.
Louis Schubert	Scientific Technologies, Inc.
Barry A. Stockton	High Tech Consulting
James T. Strother	SMACNA, Inc.

Explanation of the format of the standard

This ANSI B11.3 – 2002 standard is divided into parts formerly referred to as sections or chapters and now referred to as clauses in line with the new ANSI style manual. Major divisions of clauses are referred to as subclauses and, when referenced by other text in the standard, are denoted by the subclause number (e.g., see 5.1).

The standard uses a two-column format to provide supporting information for requirements. The material in the left column is confined to "Standards Requirements" only, and is so captioned. The right column, captioned "Explanatory Information" contains information that the writing Subcommittee felt would clarify the standard. This column should not be construed as being a part of the requirements of this American National Standard.

Operating rules (safe practices) are not included in either column of this standard unless they are of such nature as to be vital safety requirements, equal in weight to other requirements, or guides to assist in compliance with the standard.

As in all American National Standards, the term "SHALL" denotes a requirement that is to be strictly followed in order to conform to this standard; no deviation is permitted. The term "SHOULD" denotes a recommendation, a practice or condition among several alternatives, or a preferred method or course of action.

Similarly, the term "CAN" denotes a possibility, ability or capability, whether physical or casual, and the term "MAY" denotes a permissible course of action within the limits of the standard.

By convention, the B11 standards do not use the term "and/or" but instead, the term "OR" is used as an inclusive disjunction, meaning *one or the other or both.*

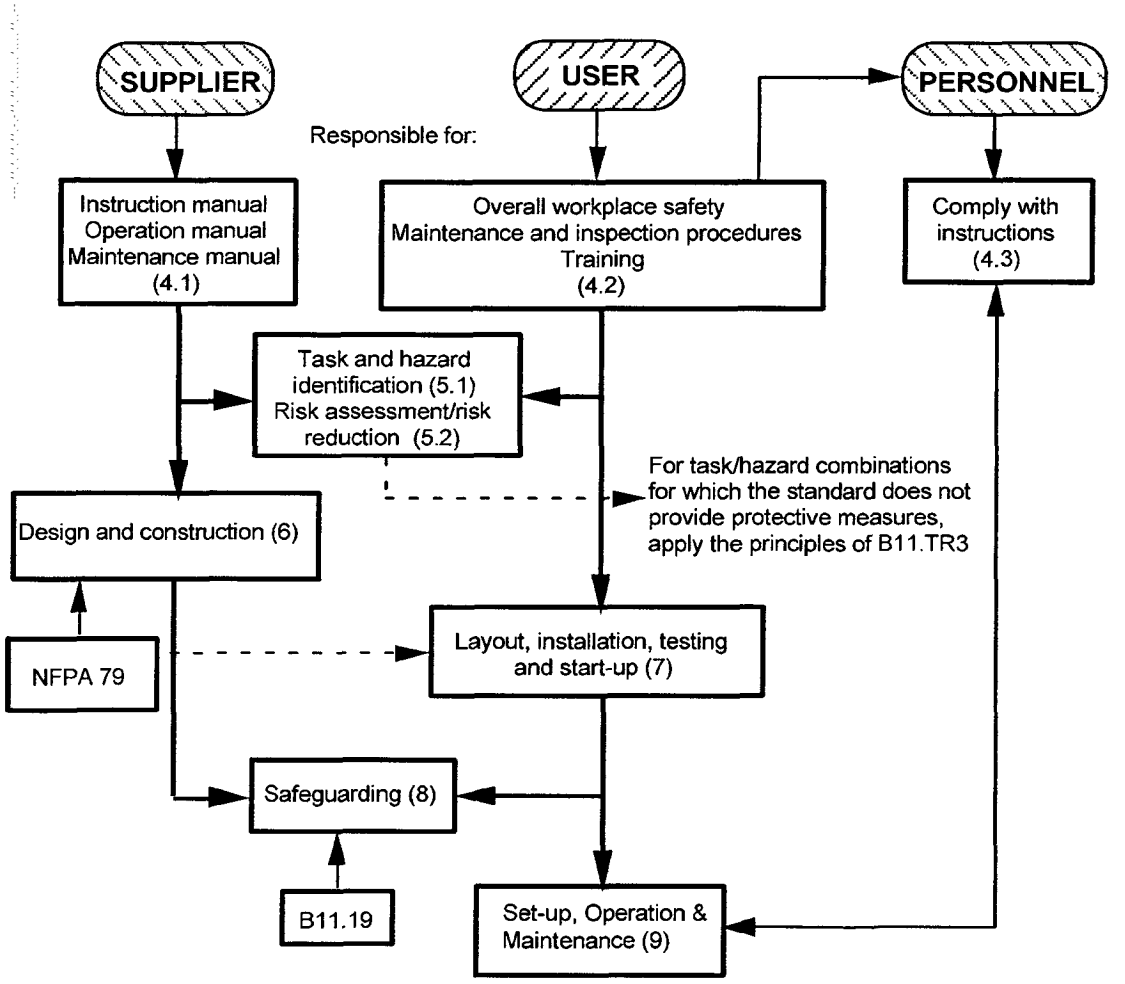
Suggestions for improvement of this standard will be welcome. They should be sent to AMT-The Association For Manufacturing Technology, 7901 Westpark Drive, McLean, VA 22102 – Attention: B11 Secretariat

Introduction

The primary purpose of every machine tool is to process parts. This is accomplished by the machine imparting process energy onto the workpiece. Inadvertent interference with, or accidental misdirection of the released energy during production, maintenance, commissioning and de-commissioning may result in injury.

The primary purpose of the ANSI B11 series of machine tool safety standards is to devise and propose ways to minimize risks of the potential hazards. This can be accomplished either by an appropriate machine design, by restricting personnel or other individuals' access to hazard areas, and by devising work procedures to minimize personnel exposure to hazardous situations. This is the essence of the ANSI B11 series of safety standards.

The responsibility for the alleviation of these risks is divided between the equipment supplier, its user and its operating personnel, as follows (numbers in parentheses refer to the clause numbers in these standards which address that responsibility):



Standard Requirements **Explanatory Information**

American National Standard for Machine Tools-

Safety Requirements for Power Press Brakes

1 Scope

1.1 General

The requirements of this standard apply to those machine tools classified as power press brakes (hereinafter referred to simply as "press brakes"), which are designed and constructed for the specific purpose of bending material.

The requirements of this standard also apply to powered folding machines.

NOTE – Where used in this standard, the terms *machine* or *system* refer to the press brake or press brake production system.

E1.1

To achieve this purpose, the press brake is provided with a plate-type ram and a plate-type bed with standard provisions for attaching standardized press brake tooling.

This machine is sometimes referred to as a "bending brake" or a "brake press."

Where used in this standard, the terms "press brake" or "press brake production system" are intended to include powered folding machines.

1.2 Exclusions

Excluded from the requirements of this standard are: mechanical power presses; hydraulic power presses; hand brakes; tangent benders; apron brakes; and other similar types of metal-bending machines.

2 Normative References

The following normative documents contain provisions that, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements subject to this American National Standard should apply the most recent editions of the normative documents listed below.

29 CFR 1910.147: *Control of hazardous energy (lockout/tagout)* (For more information, www.osha.gov)

29 CFR 1910.333: *Selection and Use of Electrical Work Practices* (For more information, www.osha.gov)

E2 Informative References

ANSI / ASME B5.56M-1994, *Specification and Performance Standard, Power Shears*

ANSI B11.TR1–1993. *Ergonomic Guidelines for the Design, Installation and Use of Machine Tools.*

Standard Requirements	Explanatory Information
ANSI B11.19-1990 (R1995), *Safeguarding When Referenced by the Other B11 Machine Tool Safety Standards Performance Criteria for the Design, Construction, Care and Operation.*	ANSI B11.TR3 -- 2000. Risk Assessment and Risk Reduction – A guide to estimate, evaluate and reduce risks associated with machine tools.
ANSI / ASME B15.1-2000, *Safety Standard for Mechanical Power Transmission Apparatus.*	ANSI Z244.1--1993, *For personal protection, Lockout/Tagout/Energy*
ANSI / ASME *Boiler and Pressure Vessel Code, 2001. Division 1 (Section VIII)*	ANSI / NFPA / JIC T2.24.1R1-2000, Hydraulic fluid power – Systems standard for stationary industrial machinery
ANSI / IES-RP-7-1991, *Industrial Lighting.*	
ANSI / NFPA 70 – 2002, *The National Electrical Code*	
ANSI / NFPA 70E,-2000, *Electrical Safety Requirements for Employee Workplaces.*	
ANSI / NFPA 79-1997, *Electrical Standard for Industrial Machinery.*	

3 Definitions

For the purposes of this standard, the following definitions apply.

3.1 actuating control: An operator control used to initiate machine motion or other machine function.

3.2 adjustable barrier guard: A guard with provisions for adjustment to accommodate various jobs or tooling set-ups.

3.3 antirepeat: The function of the control system or device that limits the machine to a single cycle.

3.4 awareness barrier: An awareness device that warns individuals by means of physical contact.

3.5 barrier guard: See *guard.*

3.6 bed: The stationary member of the machine that supports the tooling and other associated equipment.

3.7 blanking: Bypassing a portion of the sensing field of a presence-sensing safeguarding device.

3.8 brake: A mechanism for stopping, slowing or preventing motion.

Standard Requirements	Explanatory Information
3.9 bypass: To render ineffective any safety related function of the control system or safeguarding device.	
3.10 clutch: A mechanism that, when engaged, transmits torque to impart motion from a driving member to a driven member.	***E3.10*** The clutch can be disengaged at any point before the crankshaft has completed a full revolution. Full revolution clutches are not used on mechanical press brakes.
3.11 concurrent: Acting in conjunction with another; used to describe a situation where two or more actuating controls exist in an operated condition at the same time (but not necessarily simultaneously).	
3.12 continuous: Uninterrupted multiple cycles of the ram without intervening stops at the end of each individual cycle.	***E3.12*** "Continuous" is not to be confused with the type of operation known as "on the hop," which is basically a single cycle (stroke) mode wherein the tripping means is released and re-operated (to reset the anti-repeat circuit) on the upstroke of the press brake.
3.13 control reliability: The capability of the machine control system, the safeguarding, other control components and related interfacing to achieve a safe state in the event of a failure within their safety related functions.	***E3.13*** See also, *safety-related function.*
3.14 control system: Sensors, manual input, and mode selection elements, interlocking and decision–making circuitry, and output elements to the press brake operating devices or mechanisms.	
3.15 counterbalance: Means provided to balance the reciprocating mass of the ram, drive members and ram attachments.	
3.16 cycle: A complete movement of the ram from the initial start position back to the same start position.	***E3.16*** Historically, the term *stroke* has come to be used interchangeably with the term *cycle* in the "power press community." This standard uses the convention – cycle (stroke) – throughout the document. The next revision of ANSI B11.3 will simply use the term *cycle*, and will use the term *stroke* only when appropriate.
3.17 device: A component, attachment or mechanism designed to serve a specific purpose or perform a specific function.	
3.18 die(s): The tooling used in a press brake to form the material.	
3.19 die setting: The process of installing or removing dies and the process of adjusting the dies, other tooling or equipment, and the safeguarding.	

Standard Requirements	Explanatory Information
3.20 die space: The area encompassed by the ram length projected to the bed.	***E3.20*** See Figure 18, Annex A.
3.21 feeding: The process of placing the material or workpiece into the tooling, or removing the material or workpiece from the tooling.	***E3.21*** Types of feeding include but are not limited to the following: a) Automatic feeding is a mechanical means, press brake or self-driven, for placing and removing the material. A typical example is an automatic roll feed. b) Manual feeding is the process whereby the operator(s) places the material or workpiece into the tooling or removes the material or workpiece from the tooling. c) Semiautomatic Feeding typically involves the material being processed and placed within, or removed from, the point of operation by either: • A movable mechanism which is a fixed part of the tooling and which requires manual action by the operator; or • A part or material to be processed in a succeeding cycle (stroke). d) Hand-Tool Feeding. A type of manual feeding wherein the material is placed within, and processed parts removed from, the point of operation by use of a hand-feeding tool. See Figure 14, Annex A.
3.22 fluid: Any liquid or gas.	
3.23 foot control: A foot-operated mechanism or device used as an actuating control.	***E3.23*** Types of foot controls include but are not limited to: • electrical; • pneumatic; • hydraulic. See Figure 20, Annex A.
3.24 foot pedal (mechanical): A foot operated mechanical actuating control attached to the press brake operating mechanism.	***E3.24*** See Figure 2, Annex A.
3.25 foot treadle: A foot operated full-length non-removable mechanical actuating control attached to the press brake operating mechanism.	***E3.25*** See Figure 19, Annex A.
3.26 guard: A barrier that prevents entry into a hazard area.	
3.27 hand control: A hand-operated mechanism or device used as an actuating control.	

Standard Requirements	Explanatory Information
3.28 hand tool: Any device used for manual feeding or removal of a workpiece, freeing of a jammed workpiece, or removal of scrap.	***E3.28*** See Figure 13, Annex A.
3.29 hazard: A potential source of harm to individuals.	
3.30 hazard area: An area or space that poses an immediate or impending hazard.	
3.31 helper: An individual who assists in the operation, maintenance, repair or die setting of the machine.	
3.32 immediate stop command: A command that initiates an action(s) to stop a hazardous motion (or situation) at any point in the machine cycle.	
3.33 inch: To impart incremental motion to the machine by momentary manual actuation.	
3.34 individual: A particular human being.	***E3.34*** For the purpose of this standard, a distinction between *individual* and *personnel* is drawn. Individual includes personnel but encompasses persons who are not under direct or indirect control of the supplier or user (e.g., visitors, vendors, etc.). See also, *personnel.*
3.35 installer: An individual, partnership or corporation responsible for placement and preparation for use of a press brake or press brake production system.	***E3.35*** See also, *supplier.*
3.36 integrator: Any supplier that designs, provides, manufactures or assembles a press brake, its associated machines or equipment, the safeguarding, control interfaces, interconnections or the control system into a press brake production system.	***E3.36*** See also, *supplier.*
3.37 interlock: A means to permit or prevent hazardous motion or conditions.	
3.38 interlocked barrier guard: A barrier, or section of a barrier, interfaced with the press brake control system in such a manner as to prevent access to the point of operation or other hazard during normal operation.	
3.39 manufacturer: Any supplier that designs, manufactures or assembles press brakes or press brake production systems.	
3.40 material position gage: A stop against which the material or workpiece is placed to locate it within the point of operation.	***E3.40*** See Figure 1, Annex A.

Standard Requirements	Explanatory Information
3.41 mode: Specific manner or operation of a press brake or press brake production system determined by the control system.	
3.42 mode selector: A control device used to establish the press brake operating mode.	
3.43 modifier: Any supplier that changes the original purpose, function or capacity of the press brake or press brake production system by design or construction.	***E3.43*** See also, *supplier.*
3.44 monitoring: The checking of system components to detect a failure of a component, subassembly or module that affects the performance of the safety-related functions.	
3.45 movable barrier device: A safeguarding device arranged to enclose the point of operation before machine motion can be initiated.	***E3.45*** **Note that t**here are two types of movable barrier devices: a) Type A, which encloses the point of operation during the complete machine cycle; and b) Type B, which encloses the point of operation during the hazardous portion of the machine cycle.
3.46 muting: The automatic temporary bypassing of any safety related function(s) of the control system or safeguarding device.	
3.47 normal stop command: A command that initiates an action(s) to stop a hazardous motion (or situation) at the end of a press brake cycle or at other points required by the press brake functions.	
3.48 operator: An individual who performs production work on the machine and who controls the movements of the press brake.	
3.49 operator control: Any operator actuated push button, switch, lever, pedal, or other device that initiates, cycles, controls or stops press brake motion.	
3.50 operator's station: The complement of controls used by an operator to operate the press brake.	
3.51 personnel: Individuals who are employed by or on behalf of the user.	***E3.51*** Personnel includes subcontractors, consultants, or other contract workers under the indirect control of the supplier or user.
3.52 piecepart: See *workpiece.*	
3.53 pinch point: An area, excluding the point of operation or trapping space, that poses a hazard of exposure to moving parts of the press brake, its related machines or the material or workpiece.	***E3.53*** The term "pinch point," as used in this standard, refers only to hazards that can exist as a part of the press brake or its associated equipment. The term is not used to describe hazards caused by the tooling at the point of operation, since these hazards are a different

Standard Requirements	Explanatory Information
	problem and require different treatment.
3.54 point of operation: The location in the tooling where the material or workpiece is positioned and work is performed.	
3.55 presence-sensing device: A device that creates a sensing field, area or plane to detect the presence of an individual or object	
3.56 presence-sensing device initiation (PSDI): An operating mode that utilizes a presence-sensing device to actuate a single press brake cycle.	
3.57 press brake production system: A press brake and auxiliary equipment that is set up for production operations.	***E3.57*** Typically, the system may include but not be limited to: • dies (tooling); • feeding methods; • point-of-operation safeguarding; • gaging.
3.58 pullback device: A safeguarding device with attachments for the operator's hands and wrists connected to the ram or die, that when properly adjusted, prevents the operator from reaching into the point of operation, or withdraws the operator's hands from the point of operation, during the hazardous motion.	***E3.58*** See Figure 8, Annex A.
3.59 ram: The machine member that reciprocates linearly and to which the tooling is attached.	
3.60 rebuilder: Any supplier that restores the press brake or press brake production system to its original design, purpose, capacity and function.	***E3.60*** See also, *supplier.*
3.61 redundancy: The use of multiple means to perform the same function.	
3.62 restraint device: A safeguarding device with attachments for the operator's hands and wrists that prevents the operator from reaching into the point of operation at all times.	***E3.62*** See 8.6.4; see Figures 9 and 10 in Annex A (operator's restraint device for point of operation protection).
3.63 safe distance safeguarding: A safeguarding method that requires the operator to hold the workpiece, as determined by the user, so that the operator does not reach closer than the determined safe distance to the point of operation during the hazardous portion of the machine cycle.	***E3.63*** See Figure 15, Annex A.
3.64 safeguarding device: Any mechanical attachment or control device, other than a barrier guard, that:	***E3.64*** Safeguarding devices achieve this requirement by:

Standard Requirements	Explanatory Information
a) prevents inadvertent access into a hazard area by individuals during the hazardous motion of the machine; or b) prevents or stops hazardous motion of the machine when individuals are detected by the device.	a) Restraining the operator from inadvertently reaching into the hazard area; or b) Preventing normal or hazardous operation if any part if an individual's body is inadvertently within the hazard area; or c) Automatically withdrawing the operator's hands, if the operator's hands are inadvertently within the hazard area during the hazardous portion of the machine cycle; or d) Maintaining the operator or the operator's hands at a safe distance from the hazard area during the hazardous portion of the machine cycle.
3.65 safety distance: The calculated distance between a hazard and a safeguarding device.	***E.65*** See Annex D.
3.66 safety-related function: That portion of the control system or safeguarding device that eliminates exposure to a hazardous situation or reduces exposure to a tolerable level.	
3.67 single control safeguarding device: A single actuating control used to initiate or maintain machine motion located at a safe distance from the hazard.	***E3.67*** Examples of single control safeguarding devices may include a foot control or hand control fixed at a distance from the point of operation.
3.68 single cycle (single stroke): See *cycle*.	
3.69 stop control: An operator control used to initiate a machine stop.	
3.70 stroke: The movement of the ram from the open to the closed position, or from the closed to the open position.	
3.71 supplier: An individual, corporation, partnership or other legal entity or form of business that provides, or makes available for use, all or part of the press brake or press brake production system. NOTE – When the user provides any of the above services, the user is considered to be the supplier within the scope of that work activity.	***E3.71*** Besides the manufacturer, the supplier can include the manufacturer's agent, representative, or distributor, reseller, installer, modifier, rebuilder or integrator who provides equipment or services associated with the machine.
3.72 two-hand control: Actuating control that requires concurrent use of both hands of the operator to initiate or continue the press brake cycle (stroke).	***E3.72*** See 6.11.3.2; see Figures 11 and 12 in Annex A.
3.73 user: An entity that utilizes press brakes, systems, safeguarding, and related equipment.	
3.74 workpiece: Any material or part to be placed into the tooling, for having work performed upon it.	***E3.74*** Workpiece is also commonly referred to as piecepart.

Standard Requirements | **Explanatory Information**

4 Responsibility

4.1 Supplier

For purposes of this standard, the supplier can be the manufacturer, integrator, modifier, rebuilder or installer of the press brake or press brake production system.

Within the scope of the work activity, the supplier shall be responsible to ensure that the design, construction, modification, installation and safeguarding are in accordance with clauses 5, 6, 7 & 8.

4.1.1 Task and hazard identification

The supplier shall be responsible for identifying sources of hazards within the scope of their work activity in accordance with 5.1 and Annex B.

4.1.2 Risk assessment / risk reduction

The supplier shall be responsible for assessing and reducing the risks identified in 4.1.1, in accordance with 5.2.

4.1.3 Documentation (information for use)

The supplier shall be responsible for providing documentation to the user that establishes guidelines for the installation, operation and maintenance of the press brake or press brake production system.

E4.1.3

The documentation should include but not be limited to the following, where applicable:

a) performance specifications;
b) electrical or pneumatic schematics and diagrams;
c) physical environment for which the machine or production system is designed;
d) function and location of the operator controls, indicators, and displays;
e) schedules for periodic maintenance, lubrication, and inspection;
f) application of protective measures;
g) auxiliary equipment.

4.2 User

4.2.1 Task and hazard identification

The user of the press brake production system shall be responsible for identifying sources of hazards, including point of operation hazards, associated with the installation, operation and maintenance of the press brake and press brake production system in accordance with 5.1 and Annex B (B.3 and B.4).

4.2.2 Risk assessment / risk reduction

The user shall be responsible for assessing and reducing the risks identified in 4.2.1, in accordance with 5.2.

4.2.3 Installation and startup

The user shall be responsible for ensuring that installation

Standard Requirements

and startup of the press brake and press brake production system is in accordance with clause 7.

4.2.4 Safeguarding

The user shall be responsible for ensuring that safeguarding is provided, installed, maintained, and used in accordance with clause 8, for all individuals involved in the production process.

4.2.5 Operation and maintenance

The user shall be responsible for ensuring that the press brake production system is maintained and used in accordance with clause 9.

4.2.6 Training

The user shall be responsible for ensuring that supervisors, operators, maintenance, and service individuals are trained in the proper installation, adjustment, and operation of the press brake and press brake production system. See clause 9.

4.3 Personnel

Personnel shall be responsible for following the training and safety procedures provided by the user in the operation and maintenance of the press brake and press brake production system in accordance with clause 9.

Explanatory Information

E4.3

The Occupational Safety and Health Act of 1970 – Public Law 91-596, states in Clause 5(b), "Each employee shall comply with occupational safety and health standards and all rules, regulations and orders issued pursuant to this Act which are applicable to his own actions and conduct."

Standard Requirements	Explanatory Information
5 Hazard control	
5.1 Task and hazard identification Reasonably foreseeable tasks and associated hazards shall be identified throughout the lifecycle (design, installation, set-up, operation and maintenance) of the machine.	***E5.1*** Task identification should take into account, but not be limited to the following task categories: a) packing and transportation; b) unloading/unpacking; c) systems installation; d) startup/commissioning; e) set-up and tryout (debug); f) operation (all modes); g) tool change; h) planned maintenance; i) unplanned maintenance; j) major repair; k) recovery from control failure; l) recovery from a jam; m) troubleshooting; n) housekeeping; o) decommissioning; p) disposal. For each of the task categories there may be many tasks. Tasks are specific activities that relate to the task category. Each task category may have numerous tasks associated with it, such as: • loosening the upper die on press brake #4; • replacing the drive belt on motor 2; • replacing the breather unit on the hydraulic unit of press brake #6; • troubleshooting a ram repeatability problem on press brake #7; • clearing jammed workpiece between backgage and tooling on "old unreliable". For each of the above tasks, there may be numerous hazards. Examples of hazards and hazardous situations addressed within this standard (design/construction, installation, set-up, operation and maintenance) are contained in Annex B.
In addition, reasonably foreseeable hazards not directly related to tasks shall be identified.	Following are some examples of reasonably foreseeable hazards not related to tasks: • failure of a high-pressure hydraulic line; • bearing failure or bearing seizure; • failure of the structural components of the machine.
Tasks and associated hazards shall be identified and reassessed when necessary or whenever the machine is	Each time a machine is modified or its use is changed, the tasks/hazards associated with

Standard Requirements	Explanatory Information
modified or its typical use is changed (see 5.2).	the modification or change should be identified and re-assessed. For a more detailed discussion on task/hazard combination identification, refer to ANSI B11.TR3.
5.2 Risk assessment / risk reduction Risks associated with the task/hazard combinations identified in 5.1, including reasonably foreseeable hazards not directly related to tasks, shall be assessed and reduced to a tolerable level by incorporating one or more of the following protective measures, in hierarchical order:	***E5.2*** Where possible and when necessary, the user, in conjunction with the supplier, should ensure that the task/hazard combinations and reasonably foreseeable hazards not directly related to tasks identified in this standard, and their associated protective measures are appropriate for the specific machine to which this standard is being applied. For further information on risk assessment, see ANSI B11.TR3.
a) eliminate or control hazard(s) by design; b) control exposure to hazards by the use of guards or safeguarding devices; c) provide other safeguarding (e.g., awareness barriers, awareness signals and safeguarding methods); d) implement administrative controls or other protective measures (including safe work procedures, preventive maintenance, training, re-training, personal protective equipment and warning signs).	
When performing risk reduction for task/hazard combinations identified in 5.1, including reasonably foreseeable hazards not directly related to tasks, the requirements of clauses 6, 7, 8 and 9 shall be implemented.	For performing risk reduction on task/hazard combinations and reasonably foreseeable hazards not directly related to tasks not resolved by applying clauses 6, 7, 8 and 9, see ANSI B11.TR3.
Tolerable risk shall be determined by evaluating the application of the protective measures against the following factors:	Zero risk does not exist and cannot be attained. However, a good faith approach to risk assessment and risk reduction should reduce risk to a tolerable level. For further information on tolerable risk, see ANSI B11.TR3.
– risk-reduction benefit;	Risk-reduction benefit is determined by estimating the potential reduction in severity of harm or probability of occurrence of harm. The type of protective measure is determined by the nature of the task and associated hazard(s) for the machine under consideration. Protective measures should be selected to provide the desired degree of risk reduction.

Standard Requirements

Explanatory Information

- technological feasibility;
- economic feasibility;
- ergonomic impact;
- productivity;
- durability and maintainability;
- usability.

Risk reduction is complete when the protective measures, consistent with this standard, are applied and tolerable risk has been achieved for the identified task/hazard combinations and the press brake or press brake production system as a whole.

6 Design, Construction, Reconstruction, and Modification

6.1 Electrical

E6.1
For additional guidance, refer to ANSI / NFPA 79.

6.1.1 Motor starter

All press brakes, except air operated press brakes, shall incorporate a type of drive motor starter that will disconnect the drive motor from the power source in the event of control voltage or power source failure, and require actuation of the motor start button to restart the motor when voltage conditions are restored to normal.

EXCEPTION – When electronic motor controllers are utilized, they shall stop or prevent motor motion in the event of control voltage or power source failure and require reactivation of the motor controller system when voltage conditions are restored to normal.

6.1.2 Motor start button

When provided, the motor start button shall be protected against unintentional actuation.

6.1.3 Stop functions

6.1.3.1 Stop control

A stop control shall be provided on all press brakes.

E6.1.3.1
The disconnect switch can be considered a stop control. See ANSI / NFPA 79.

Each machine shall have provisions to connect additional stop controls, as required by the press brake production system.

The supplier may not know the required location of all stop controls.

Stop controls shall be located at each operator control station, readily accessible to each foot control, and at other locations where individuals may be exposed to hazards during normal operation of the press brake.

Actuation of the stop control, whether a momentary or a latching type, shall immediately initiate stopping action of the hazardous motion. Resumption of motion shall require that the normal actuating means be reactivated.

The stop control described in this document is referred to in ANSI / NFPA 79 as an emergency stop. Latching type stop controls are typically reset mechanically or electrically.

Standard Requirements

The stop control shall be arranged with hardwired electro-mechanical components that function independently of programmable electronic systems (PES) to initiate stopping action.

The stop control shall be red in color and unobstructed.

6.1.3.2 Top stop control
When provided, a top stop control shall stop the press at the completion of its normal cycle. Resumption of ram motion shall require re-actuation of the normal actuating means. A top stop control shall be yellow in color and be unobstructed.

6.1.4 Return (stop-return) control
When provided, the return control shall stop the closing motion of the ram or return the ram to the top or initial starting position. Resumption of closing motion shall require re-actuation of the normal actuating means. It shall be yellow in color and unobstructed.

When the stop function is combined with other functions such as stop return, the stop portion of the control shall be considered a stop control. See 6.1.3.1.

6.1.5 Voltage
All ac control circuits and solenoid valve coils shall be powered by not more than a nominal 120 volt ac supply obtained from a transformer with an isolated secondary. Higher voltages that may be necessary for operation of machine or control mechanisms shall be isolated from any control mechanism handled by the operator, but motor starters with integral start-stop buttons may utilize line voltage control. All dc control circuits shall be powered by not more than a nominal 250 volt dc supply isolated from any higher voltages.

6.1.6 Grounds
Ground faults in the control circuits shall not cause unintentional motion or prevent stopping of the press brake.

6.2 Performance of the safety–related function(s)
The control system shall meet the requirements of 8.3.

6.3 Die fastening provisions
All press brakes shall be provided with a die clamping means to allow for the mounting and secure fastening of the die holder and dies, and shall have provisions made to permit alignment.

Explanatory Information

E6.1.4
The return functions include, but are not limited to, one of the following:
1) Momentary actuation of the return control will cause ram closing motion to stop and automatically return to initial ram position; or
2) Momentary actuation of the return control will cause ram closing motion to stop. To return to the initial ram position, continuous or intermittent actuation of the stop-return control may be used.

Standard Requirements	Explanatory Information
6.4 Opening of die space A means shall be provided for the opening of the die space in the event that the completion of the closing stroke cannot be safely accomplished.	***E6.4*** Some methods to accomplish this are, but not limited to: • Die height adjustment; • Reverse drive motor; • Return (opening) mode on a hydraulic press brake.
6.5 Material position gages When provided, material position gages used as back gages shall be designed and constructed so as to inhibit material from bypassing the gage.	***E6.5*** A step gage is another acceptable common type of gage. It is not the intent of this paragraph to preclude the use of step gages, provided they are of proper construction so as not to create a hazard to operating personnel. Often, gages are built into special purpose dies. A magnetic material position gage, when properly designed, can provide for the removal of an operator's hands from the workpiece thereby allowing the use of a two-hand operator's control station during the hazardous portion of a machine cycle. See Figure 1, Annex A.
6.6 Ram counterbalance systems **6.6.1 Spring counterbalance** **6.6.1.1 Retaining broken parts** Spring counterbalance systems, if provided, shall incorporate means to retain system parts in the event of breakage.	
6.6.1.2 Capability Spring counterbalance systems, if provided, shall have the capability of holding the ram and its attachments at mid-stroke, without brake applied.	
6.6.2 Air (pneumatic) counterbalance **6.6.2.1 Retaining broken parts** Air counterbalance cylinders, if provided, shall incorporate means to retain the piston and rod in case of breakage or loosening.	
6.6.2.2 Capability Air counterbalance systems, if provided, shall have the capability of holding the ram and its attachments at any point in the cycle (stroke) without brake applied.	
6.6.2.3 Air supply failure Air counterbalance cylinders, if provided, shall incorporate means to prevent failure of capability (sudden loss of pressure) in the event of air supply failure.	***E6.6.2.3*** Common practice is to use a check valve in the air supply to the counterbalance.

Standard Requirements	Explanatory Information
6.7 Ram support system When a ram support system is provided on a hydraulic press brake it shall have sufficient capacity to stop the motion of the ram and its attachments at any point in the travel when pressure is removed. Drifting of the ram shall be limited to a speed that does not present a hazard to the operator.	*E6.7* The ram support system is sometimes referred to as counterbalance system. Depending on design, a wide variety of counterbalance systems may exist. The system should be designed so that loss of power effectively stops the ram and its attachments. Where multiple return cylinders are used, consideration should be given to using a separate counterbalance valve on each cylinder. Where a single return cylinder is used, redundancy of the valve should be considered. The counterbalance valve should be mounted as close to the cylinder as possible, with emphasis on the reliability of the connection.
6.8 Clutches and brakes Brakes and clutches of mechanical press brakes shall be actuated in a coordinated manner. The clutch shall not fail to disengage and the brake shall not fail to engage upon release of the actuating force.	
6.8.1 Friction Brakes Friction brakes shall be engaged by compression spring(s), guided on a rod or in a hole and be prevented from interleaving. A disengaging force shall be required to release the brake. Brake capacity shall be sufficient to stop the motion of the ram when the disengaging force is removed and to hold the ram and its attachments at any point in the ram's travel.	
6.8.2 Clutches Mechanical and fluid-operated clutches shall be of the friction type and shall self-disengage when the external engaging force has been removed.	
6.8.3 Clutch and brake air valve failure Air valves used to actuate friction clutch and brakes shall be designed to ensure that there is no significant increase in the normal stopping time of the press brake ram motion due to a failure within the operating valve mechanism. Further press brake ram motion shall be prevented if such failure does occur.	*E6.8.3* The use of a monitored dual air valve is one method of meeting this requirement.
6.9 Engaging method failure The clutch and brake control of air actuated press brakes shall automatically deactivate in the event of the failure of adequate air-pressure supply for the actuating control. Reactivation of the ram motion shall require restoration of normal air supply and re-initiation of the operator's control.	

Standard Requirements

6.10 Cycle (stroke) control of mechanically actuated or air operated press brakes

A machine with a mechanically actuated clutch and brake or an air cylinder driven air operated press brake shall be designed so as to allow the die setter to have complete control over the ram movement for setting dies.

6.10.1 Foot pedal (mechanical)

When provided, a mechanical foot pedal shall have a pad that will allow even distribution of the actuating pressure as applied by the operator's foot. The pad shall have a non-slip contact area and shall be firmly attached to the mechanical foot pedal. The mechanical foot pedal shall be removable, and adjustable to the left or right, to permit actuation by the operator at a location to suit the work.

6.10.2 Unattended actuation of press brake by foot pedal

When provided, a mechanical foot pedal shall be equipped with a means for preventing unattended machine actuation.

6.10.3 Unattended actuation of press brake by foot treadle

When provided, a foot treadle of the type that serves as an operator control shall be equipped with a means to prevent unattended machine actuation.

6.10.4 Foot control

When provided, foot controls shall be protected to prevent actuation from falling or moving objects, or from unintended actuation.

Explanatory Information

E6.10

Special operator training on mechanically actuated press brakes is recommended because the operator has complete control of the ram movement during production and set-up. See 9.2.3 for additional information on training requirements.

E6.10.2

Two methods of fulfilling this requirement are:

a) Removing the mechanical foot pedal and placing it in a safe location.
b) Providing a locking pin or locking lever, as noted in Figure 2, Annex A. These locking mechanisms should be designed to prevent unattended machine actuation. The locking mechanism should not allow locking in the operating position. For additional operator safety in mechanical foot pedal type operations, the locking device (pin or lever) is recommended to be used to prevent actuation of the press brake when not in operation.

E6.10.3

Two methods of fulfilling this requirement are, but not limited to the following:

a) Providing a protective cover over the treadle bar to prevent unattended machine actuation;
b) Providing a locking pin or locking lever to lock the treadle bar in a fixed position. These locking mechanisms should be designed to prevent unattended machine actuation. The locking mechanism should not allow locking in the operating position See Figure 2, Annex A.

Standard Requirements	Explanatory Information
6.11 Mode control for hydraulic, pneumatic and electrically actuated press brakes The mode control shall be designed and constructed in accordance with 8.3.	
This section does not apply to mechanically actuated press brakes or air operated press brakes without control systems.	
6.11.1 Mode selection A means for selecting a mode of operation shall be provided. This means shall be capable of being supervised by the user. "Off" and other modes of operation for set-up and production such as but not limited to, "inch" and "single" shall be supplied within the ram cycling (stroking) control system. Fixing of the selection shall be by a means capable of being controlled by the user. Changing of the selection from one mode to another shall not cause ram movement.	***E6.11.1*** A key locking requirement is not intended.
6.11.1.1 Off "Off" position on the mode selector switch shall make the press brake inoperative by removing power from the machine actuators.	
6.11.1.2 Inch The "inch" operating mode shall be designed such that ram motion can only occur while the actuating control is held actuated.	***E6.11.1.2***
The "inch" operating mode shall not be used for producing parts during normal operation.	When a single or two-hand control is used as a safeguarding device, see clauses 8.6.5 and 8.6.6.
6.11.1.3 Single cycle (stroke) An operator control for single cycle (stroke), when provided, shall conform to the following requirements: a) The control system shall be designed to require that the actuating control be held actuated during the hazardous portion of the cycle (stroke); b) The control system shall be designed to require the release of all actuating control from the operator(s) control station before an interrupted cycle (stroke) can be resumed; c) The control system shall incorporate an anti-repeat feature.	***E6.11.1.3*** The point at which the actuating control may be released for automatic ram opening may need to be adjusted for each set-up.
EXCEPTION for (a) and (b) above – For PSDI applications, see 6.13 and clause 10 for the requirements.	
6.11.1.4 Continuous The selection of "continuous" mode shall be capable of being supervised. The initiation of continuous cycling (stroking) shall require a deliberate action by the operator and the actuation of the normal operating means.	***E6.11.1.4*** Methods for meeting this requirement include but are not limited to the following: 1) To obtain continuous cycling (stroking), the following sequence must be observed:

Standard Requirements

Explanatory Information

a) The supervisory "off/on" selector switch must be turned on with a key;
b) The mode selector must be turned to "continuous;"
c) The "continuous set-up" button must be momentarily depressed;
d) The normal actuating means must be actuated within a predetermined time after the set-up button is depressed.

2) Another method capable of meeting the intent of this standard includes the use of an entirely different operator's station for "continuous" operation requiring the following sequence:
a) Issuing a special operator's control station from the user's supervised storage;
b) Requiring a special plug-in connection to the press brake;
c) Turning the mode selector to "continuous;" and
d) Actuation of the continuous actuating means.

3) A third method capable of meeting the intent of this standard is to use the following sequence:
a) The supervisory "off/on" selector switch must be turned on with a key;
b) The mode selector must be turned to "continuous;"
c) The normal actuating means must be held actuated well into the second cycle (stroke) before "continuous" is achieved.

6.11.1.5 Operator-maintained continuous
A control system that provides an operator-maintained continuous cycling (stroking) mode shall require the selection of the "operator-maintained continuous" mode and a prior action or decision by the operator before operation of the actuating control will initiate cycling. If the actuating control is released, the ram shall stop at the completion of the cycle (stroke) in progress.

E6.11.1.5
The intent of this requirement is to establish a method of initiating cycling (stroking) in the "operator-maintained continuous" mode that is distinguishable from the initiation or enabling of cycling in other modes.

One method of meeting this requirement is to perform the following sequence:
1) Select the operator-maintained continuous mode;
2) Momentarily depress an "operator-maintained continuous" set-up (arming) button;
3) Manually operate and hold the actuating control within a predetermined time after the set-up (arming) button is pressed to initiate and maintain continuous cycling.

Another method of meeting the intent of this

Standard Requirements	Explanatory Information
	requirement is to use a different actuating control to initiate operator-maintained continuous cycling (stroking) than is used to initiate or enable cycling in other modes. With this method: 1) Select the "operator-maintained continuous" mode; 2) Manually operate the actuating control that is used to initiate operator-maintained continuous cycling (stroking) only and hold to maintain continuous cycling.
6.11.1.6 Automatic single cycle (stroke) When a control system provides an "automatic single cycle" (stroke) mode:	***E6.11.1.6*** The intent of this requirement is to establish an enabling method for cycling in the "automatic single cycle" (stroke) mode that is distinguishable from the enabling or initiation of cycling in other modes.
The enabling of automatic single cycle (stroke) cycling action shall require the selection of the "automatic single cycle" (stroke) mode and a prior action or decision by the operator before operation of the manual actuating control either: a) Manually initiates the first cycle (stroke), after which the automatic single cycle signal is enabled to initiate single cycles as required; b) Directly enables single cycle (stroke)s to be initiated by the automatic single cycle signal without a manually initiated first cycle.	One method of meeting the intent of this requirement is to establish an enabling method for automatic single cycle (stroke) that is distinguishable from the enabling or initiation of cycling in other modes. One method capable of meeting the intent of this requirement is to perform the following sequence: 1) Select the "automatic single cycle" mode; 2) Momentarily depress an "automatic single cycle set-up" (arming) button; 3) Manually operate the actuating control within a predetermined time after the set-up (arming) button is depressed to enable cycling. Another method of meeting the intent of this requirement is to use a different manual actuating control to enable cycling in automatic single cycle (stroke) than is used in other modes. With this method: 1) Select the automatic single cycle mode; 2) Manually operate the actuating control used to enable cycling in automatic single cycle mode only.
A timer shall be provided to prevent cycling in the "automatic single cycle" (stroke) mode if the time between automatic single cycle actuation signals exceeds a predetermined time established by the user. Cycling must be manually re-enabled by the use of the procedure above when the predetermined time is exceeded.	The time limit should be set for the shortest practicable duration for the production requirements of the operation being performed. Adjustment means for the timer should be capable of supervision.
A stop signal from any source shall stop any cycling action of the press brake and shall prevent further cycling until automatic single cycle (stroke) is manually re-enabled by the use of the procedure above.	Stop signals from remote stop controls on associated machinery intended to stop the entire production process, "Top Stop" controls, the press brake drive motor stop control,

Standard Requirements	Explanatory Information
	interlocked guards, etc. are signals which should stop the press brake and prevent cycling until automatic single cycle (stroke) is manually re-enabled. Lack of the automatic single cycle signal for periods shorter than the predetermined time is not a stop signal and will not prevent further cycling from being initiated by the automatic single cycle signal.
The system shall incorporate single cycle (stroke) capability.	
6.11.2 Ram speed change When provided, the ram speed change control shall be designed and constructed to be capable of being supervised by the user.	***E6.11.2*** One reason for this mode is to provide a high speed ram approach to a predetermined point, where the ram transitions to a slow speed workpiece bending operation and then switches to a high speed ram return motion in order to complete the ram cycle. The purpose of the slow speed bending provision is to reduce any whip-up hazard when the operator must support, hand hold, and follow the extended free end of a workpiece component through the completion of the bend.
6.11.3 Actuating control **6.11.3.1 Foot control** When provided, foot controls shall be protected to prevent actuation from falling or moving objects, or from unintended actuation.	
6.11.3.2 Two-hand control When a two-hand operator control is provided, each hand control shall be protected against unintended actuation and arranged by design, construction, or separation, or a combination thereof, so that the concurrent activation from both hands is required to actuate the press brake.	***E6.11.3.2*** The use of ring guards around the hand buttons protects them from unintended actuation. Precautions in design or installation are needed to prevent actuation of two buttons by the hand and elbow of the same arm or other attempts to circumvent the two-hand control requirement. When used as safeguarding, see clause 8.6.5.
6.11.3.3 Actuating control selector If a two-hand operator control and a foot control station is provided, the method of selecting between the two-hand operator's control or foot control station shall be separate from the cycling (stroking) control selector and shall be designed so that the selection of either may be supervised and controlled by the user.	
6.11.3.4 Multiple operator stations Press brake control systems providing for more than one operator station shall be designed to be activated and deactivated as a complete operating station by a means capable of being supervised and controlled by the user. The press brake control system shall be designed and constructed to prevent initiation of a cycle (stroke) if all operator stations are bypassed.	

Standard Requirements	Explanatory Information
6.11.3.5 Sequenced operator control systems When a sequenced operator control system is used, the system shall be designed and constructed so that mode selection is capable of being supervised by the user.	***E6.11.3.5*** One type of sequenced operator control system would allow an automatic transfer from two-hand control for safeguarding during the hazardous portion of the cycle to foot control for non-hazardous machine motion.
6.12 Fluid pressure data plate Press brakes having adjustable pressure regulating devices shall have the rated pressure posted near the pressure regulating device.	***E6.12*** Components which require pressure regulating devices may include but not be limited to: • Pneumatic friction clutches; • Counterbalances; • Pneumatic regulators; • Hydraulic relief valves.
6.13 Presence-Sensing Device Initiation (PSDI) When a press brake control system provides a PSDI mode: The control system shall require a set-up/reset action by the operator after selection of PSDI mode, or after cycling is disarmed by any stop signal, to arm the PSDI mode so that the presence-sensing device can be used to initiate cycles.	***E6.13*** Some methods of meeting this requirement include, but are not limited to: 1) Arming method: a) Select the PSDI mode; b) Momentarily depress a "PSDI Set-up / Reset" (arming) button; c) Break the presence-sensing device field the required number of times (single break or double break) within a predetermined time after the set-up (arming) button is pressed to initiate a cycle. 2) Hand control method: a) Select the "PSDI" mode; b) Manually actuate the operator hand control(s) to initiate the first cycle; c) Break the presence-sensing device field the required number of times (single break or double break) within a predetermined time after the first cycle is completed to initiate the next cycle with the presence-sensing device. NOTE – The term "break" as used with PSDI operations refers to one intrusion into, and subsequent withdrawal from, the sensing field of the presence-sensing device.
The PSDI system should discriminate between a break and rapid changes of the presence-sensing output.	Rapid changes can occur from fingers or parts passing into and out of the sensing field. One method to meet this requirement is to establish a minimum time between presence-sensing field interruption and clear signals.
PSDI shall only be used to initiate no more than a single cycle.	The ram may be stopped at a predetermined point in the cycle for insertion or positioning of the piece-part.

Standard Requirements	Explanatory Information
A timer shall be provided to disarm cycling in the PSDI mode if the time between cycles exceeds a predetermined time established by the user. Rearming of PSDI cycling shall require use of the set-up/reset action above.	The time limit should be set for the shortest practicable duration for the production requirements of the operation being performed. Adjustment means for the timer should be capable of supervision.
A STOP signal from any source shall stop any cycling action of the press and shall prevent further cycling until PSDI is manually rearmed by use of the set-up/reset action above.	Examples of STOP signals that should stop and disarm PSDI mode cycling are those that result from: a) intrusion into the presence-sensing field of a presence-sensing device used for PSDI after the required number of breaks, or during the hazardous portion of a cycle; b) the actuation of the RED STOP control(s) of 6.1.3.1; c) actuation of TOP STOP controls; d) actuation of the press drive motor stop control; e) stop signals from any supplementary safeguarding.
When a means is provided to select the number of breaks required to initiate a cycle, the selection means shall be capable of supervision.	Depending on the production operation, more than one break may be necessary to initiate a cycle.
If more than one break is used to initiate a cycle, a means of indicating the position in the PSDI break sequence shall be provided.	One means of accomplishing this is with indicator lights.
A means shall be provided to indicate to the operator when PSDI is armed.	One means of accomplishing this is with an indicator light.
Any change in the selection of mode or number of breaks required to initiate a cycle shall stop any cycling action and shall prevent further cycling until PSDI is manually rearmed by use of the set-up/reset action above.	
See clause 10 for additional requirements.	

Standard Requirements	Explanatory Information
6.14 Hydraulic components and circuits	***E6.14*** For more information, see ANSI / NFPA / JIC T2.24.1 (2000).
6.14.1 Pressure rating of components The safe operating pressure rating of all hydraulic components shall be greater than the maximum rated working pressure of the press brake.	***E6.14.1*** Examples of hydraulic components may include, but not be limited to: • valves; • accumulators; • cylinders; • regulators; • fittings; • pumps; • piping.
6.14.2 Over–pressure protection Over–pressure protection shall be provided to ensure that the maximum rated working pressure of the press brake is not exceeded.	
6.14.3 Decompression A means of decompression shall be provided when needed to reduce hydraulic shock.	
6.14.4 Intensification of pressure Provisions shall be made to prevent hazardous effects of intensification.	
6.14.5 Hydraulic components and circuits Hydraulic component circuits that control ram motion shall comply with the requirements of 6.2 (and 8.3).	
6.14.6 Pressure vessels / accumulators A container used to store fluid under pressure to provide a source of power is considered to be a pressure vessel. All pressure vessels used in conjunction with press brakes shall conform to Section VIII of the ANSI / ASME Boiler and Pressure Vessel Code, Division 1.	***E6.14.6*** A pressure vessel is a storage tank or container for a fluid (gas or liquid) under gage pressure above 100 kPa (15 psi) intended as a means of energy storage or control, and has a cross section larger than the system tubing or piping. In most cases, the supplier will not actually manufacture the pressure vessel, however, the supplier should procure a pressure vessel that has been manufactured according to that code.
6.14.6.1 Shut–off Means shall be provided to vent or isolate accumulator fluid pressure from causing unintended ram motion.	
6.14.6.2 Charge When accumulators are used with flammable fluid systems, the accumulator shall be charged with inert gas.	

Standard Requirements	Explanatory Information
6.14.7 Cylinder(s) A means shall be provided to prevent pistons from causing a hazard by stroking beyond their design limits.	*E6.14.7* An example of this hazard is that a single–acting piston could leave its cylinder if stroked beyond its design limits. Some items that may be used to meet this requirement are: 1) a cam–operated valve; 2) a full–tonnage positive stop.
6.14.8 Hydraulic fluid quality Hydraulic fluid quality shall be maintained as required to prevent hazardous motion of the press brake.	*E6.14.8* Some means of accomplishing this are: 1) pressure or return–line filtration; 2) recirculating filtration; 3) external conditioning such as portable filtration unit; 4) micronic air breathers.
6.14.9 Temperature control If necessary, a means shall be used to maintain the fluid temperature level within the fluid specifications and the system's operating limits.	*E6.14.9* This may require heating or cooling of the fluid. Excessive hydraulic fluid temperature may pose a hazard to personnel.

7 Layout, installation, testing and start-up

7.1 General

The user shall develop a plan for the installation of the press brake and associated equipment.

The installation shall conform to:

a) applicable local, state and federal regulations;
b) ANSI / NFPA 70;
c) ANSI / NFPA 70E;
d) ANSI / NFPA 79;
e) requirements or recommendations from the suppler;
f) the requirements of this clause.

7.2 Layout

The layout shall provide space for safe access to and egress from the press brake and associated equipment.

7.2.1 Production operations

The layout shall provide clearance between machines and associated equipment so that the normal movement of individuals assigned to production or material-handling tasks will not interfere with or distract other assigned individuals.

7.2.2 Cleaning and maintenance

The layout shall provide necessary clearance between machines, associated equipment and building columns or walls to ensure that cleaning, maintenance or repair tasks can be performed without introducing hazards to individuals.

Standard Requirements	Explanatory Information
7.2.3 Foundation The floor or foundation on which the press brake and associated equipment is to be installed shall be capable of bearing the anticipated load.	*E7.2.3* Where applicable, dynamic loads during operation should be considered.
7.2.4 Anchoring The press brake shall be anchored to prevent tipping or moving during operation.	*E7.2.4* This means attaching to the floor or using appropriate anchors or mounts.
7.3 Installation.	
7.3.1 Safety considerations Individuals shall be protected from hazards during installation. Refer to clause 5 and Annex B.2 for additional information.	*E7.3.1* Hazards associated with the installation may include, but are not limited to: • physical hazards (e.g., electrical, mechanical); • chemical hazards (e.g., acids, cleaners, etc.); • slip/trip and fall hazards; • accessibility or space limitations; • noise as it affects communication; • rigging practices.
7.3.2 Lockout/tagout Means shall be provided to disconnect and isolate all sources of hazardous energy during installation of the press brake and associated equipment. A formal lockout/tagout procedure in accordance with 29 CFR 1910.147 & 1910.333 shall be implemented prior to beginning the installation process.	
7.3.3 Supervision The use of the lockout/tagout procedure during installation shall be enforced by installation supervision.	
7.3.4 Lighting The level of illumination of work areas of the press brake and associated equipment shall conform to the applicable requirements of ANSI / IES RP-7.	
7.4 Testing and startup	
7.4.1 Procedures Where applicable, the user shall ensure that testing and startup procedures are provided and used. See also 29 CFR 1910.147 and 1910.333.	
7.4.2 Assigned personnel Only trained personnel shall be assigned to operate the press brake and its associated equipment during testing and startup.	
7.4.2 Safeguarding	

Standard Requirements	Explanatory Information
If operational safeguarding is not in place during testing and startup, other safeguarding means shall be provided and used, in accordance with clause 8.	

8 Safeguarding

8.1 Hazards associated with moving parts

Hazards associated with moving parts (other than the point of operation hazards), such as power transmission, shall be safeguarded in accordance with ANSI / ASME B15.1.

E8.1

These hazards include but are not limited to:

- Rotating components such as the flywheel, gears, sheaves, and shafts in close proximity to individuals;
- In-running nip points such as meshing gears and belts;
- Pinch points between moving and stationary components.

8.2 Hazards associated with falling or broken components

Press brake components shall be designed, secured, or covered to minimize hazards caused by:

- breakage;
- loosening and falling;
- release of stored energy.

8.3 Performance of the safety–related function(s)

When a component, module, device or system failure occurs, such that it or a subsequent failure of another component, module, device or system would lead to the inability of the safety-related function(s) to respond to a normal stop command or an immediate stop command, the safety-related function shall:

a) prevent initiation of hazardous machine motion (or situation) until the failure is corrected or until the control system is manually reset; or

b) initiate an immediate stop command and prevent re-initiation of hazardous machine motion (or situation) until the failure is corrected or until the control system is manually reset; or

c) prevent re-initiation of hazardous machine motion (or situation) at the next normal stop command until the failure is corrected or until the control system is manually reset.

E8.3

Because some failures cannot be detected until the completion of a cycle or a portion of the cycle, loss of safety functions may occur for a portion of the machine cycle.

Other failures cannot be detected until a demand is made on the safety-related function. An example of such a safety-related function may be the use of an electro-optical device protecting a hazard area where individuals do not normally enter the area during a normal machine cycle. When a failure is detected, the safety-related function should meet the requirements of 8.3.

In the presence of a failure, the user shall be responsible to ensure that repetitive manual reset of the system or device is not used for production operation.

In the presence of a failure, this standard recognizes that some control systems or devices can be manually reset or can be reset by cycling the power to the system or device off and on.

The intention of a manual reset is to encourage the diagnosis of a failed component, subassembly, device or module. A second failure may occur during the

Standard Requirements	Explanatory Information
	diagnostic or troubleshooting process, negating the safety function(s). Additional safeguarding should be used to protect individuals during this process. Control reliability: a) is one of the design strategies that may be used to meet these requirements; b) cannot prevent a repeat cycle in the event of a major mechanical failure or in the presence of multiple simultaneous component failures; c) is not provided by simple redundancy. There must be monitoring to assure that redundancy is maintained. For further information on safety-related functions, see B11.19 (or Annex C).
8.4 Hazards associated with the point of operation The user shall provide point of operation safeguarding, in accordance with the provisions of 5.2, and implemented in accordance with 8.4.1, for all individuals exposed to the hazards associated with the point of operation.	***E8.4*** Some of the items the user should consider in selecting the appropriate point of operation safeguarding include but are not limited to: • Type and capacity of the press brake; • Type of tooling to be used; • Type of fixtures and backgaging; • Method of loading and unloading the workpiece; • Bending process; • Operators, helpers, and others exposed to the hazards associated with the point of operation. Some machines have more than one moving member that may require safeguarding during various portions of the machine cycle. One example is a moving beam on a powered folding machine. Automatic backgages can create hazardous motion and may require additional safeguarding.
8.4.1 Safeguarding provisions Safeguarding shall be provided for the hazards associated with the point of operation during the machine cycle by one or more of the following ways: a) a point of operation guard (see 8.5); b) a point of operation device (see 8.6); c) safe distance/safeguarding (see 8.7). This requirement shall not apply when the point of operation opening is 6 mm (¼ inch) or less and no other hazardous motion occurs during the cycle.	***E8.4.1*** See Annex E. Due to manufacturing constraints, the use of point of operation guards or devices cannot be used on some bending operations. On those operations, the safe distance may be acceptable.
Hazards may be created by the movement of the workpiece during the bending portion of the cycle and shall require	For example, the moving workpiece may create a pinch point between itself and a component of

Standard Requirements	Explanatory Information
alternative safeguarding.	the forming system such as the face of the tooling, the ram or bed, or material support or gage arms. This hazard is often addressed by applying specific material handling procedures. See also, Figure 3, Annex A.
8.4.2 The safeguarding shall not create a hazard between itself and other machine components, auxiliary equipment, or the workpiece.	
8.5 Barrier guards, fixed, adjustable, and interlocked	
8.5.1 Design and construction	
8.5.1.1 Material used in the construction of barrier guards shall be of such design and strength as to protect individuals from hazards associated with the point of operation.	***E8.5.1*** See Figure 17, Annex A. ***E8.5.1.1*** When a recognized hazard exists from objects flying out of the machine tool, the guard should be designed and the materials should be of sufficient strength to protect the operator from the hazard. During the design and construction of the guard environmental hazards such as noise and air contaminant should be considered.
8.5.1.2 Barrier guards shall be free of sharp edges, burrs, slag welds, fasteners, or other hazards that may injure individuals when handling, removing or using the guards or equipment.	
8.5.1.3 The design and construction of the barrier guard shall ensure that individuals cannot reach the hazard by reaching over, under, around, or through the barrier guard. Barrier guard openings shall conform to Table D1 and Figure D10 in Annex D.	***E8.5.1.3*** Other guards, safety devices or methods may be used in conjunction with barrier guards to accomplish this requirement. The safeguarding supplier should provide instructions to the user for the proper installation and use of the barrier guard.
8.5.1.4 Barrier guards shall be designed and constructed so as to ensure ease of use.	***E8.5.1.4*** Barrier guards that are burdensome (overly large, heavy or cumbersome) to individuals may discourage proper use.
8.5.1.5 The guard shall be designed and constructed to provide visibility of the hazard area appropriate for the particular operation.	***E8.5.1.5*** Where viewing of machine operation is required through the guard, materials shall be selected with suitable properties, e.g., if perforated material or wire mesh is used this should be of adequate open area and suitable color to permit viewing. Viewing will be enhanced if the perforated material is darker than the area observed.
8.5.1.6 Interlocked barrier guards shall be designed and constructed to meet the following additional requirements:	***E8.5.1.6***

Standard Requirements	Explanatory Information
a) Interlocked devices used in conjunction with barrier guards shall be specifically designed and constructed for use in safeguarding applications.	a) Some electrical interlock devices increase reliability of operation by the use of positive opening contacts that are forced open by the insertion or removal of the interlock actuator through non-resilient (non-spring) members. There are similar devices available for fluid power interlocking. The use of two interlock devices that are checked by electrical or fluid power circuits for proper operations can also greatly increase the reliability of the interlock function. The devices should be checked frequently for proper operation.
b) Interlocked devices shall not be easily bypassed by unauthorized personnel.	b) Interlocks should be designed to discourage bypassing the interlock in a simple manner with readily available items such as tape, pieces of metal, screws, tools, etc. Some interlock devices use special keys or actuators that make the interlock more difficult to bypass. There are also interlocking devices that physically obstruct or shield the interlock with the guard open and others that use electrical, mechanical, magnetic, or optical coding.
c) Interlocked barrier guards shall be designed and installed such that when the interlock is opened, re-closing the interlock shall not in itself cause any hazardous motion of the machine tool.	c) Restarting the equipment should require a deliberate action such as re-actuating the normal machine cycle control. Interlocks that serve as a safeguarding means are not by themselves always able to protect personnel in the area when jogging or cycling the machine during set-up or maintenance operations. Care should be taken during these operations to protect these individuals.
d) Handles placed on interlocked barrier guards shall be so placed and secured to the guard as to not create a pinch point between the handles and the guard, frame, or machine so affixed.	d) Handles should be placed away from the outer edge of the guard. The placement of the handle a couple of inches from the closing edge and perhaps at an angle should protect and prevent possible hand injuries.
8.5.2 Installation and operation	
8.5.2.1 Attachment of the barrier guard to the machine or the hazard area shall ensure that individuals can not reach the hazard by reaching over, under, around, or through the barrier guard. Barrier guard openings shall conform to Table D1 and Figure D10 in Annex D.	***E8.5.2.1*** Other guards, devices, or methods may be used in conjunction with barrier guards to accomplish this requirement.
8.5.2.2 Adjustable barrier guards shall be adjusted to ensure that individuals cannot reach the hazard by reaching over, under, around or through the guard.	***E8.5.2.2*** The adjustment of barrier guards should be checked and readjusted, if necessary, after each set-up or tooling change.
8.5.2.3 All interlocked barrier guards shall be interfaced with the machine control system such that no hazardous motion can occur if the interlock is open.	

Standard Requirements	Explanatory Information
8.5.2.4 The interlocked section of the interlocked guards shall be prevented from opening until hazardous motion has ceased or shall be located so that an individual cannot reach the hazard before cessation of the hazardous motion when the interlocked section is open.	***E8.5.2.4*** An interlocked device is not intended to be used as a stop control. Refer to Annex D for guidance in determining the safety distance.
8.5.2.5 Barrier guards shall be installed, maintained, and operated so as to protect against: a) Unauthorized adjustment or circumvention; b) Hazards between the guard and moving machine or tooling parts. Visibility of the point of operation shall be considered when locating the guard.	***E8.5.2.5*** Guards installed in such a manner that tools are necessary for their adjustment or removal may satisfy this requirement. Training and supervision in the adjustment, care, and operation of the safeguarding are necessary to ensure its proper use. Examples of some types of fasteners that should not be used are: a) Wing nuts or magnets; b) Latches and hasps; c) Hooks and eyes.
8.5.2.6 Barrier guards which are frequently removed or that have movable or hinged sections shall be interlocked.	
8.6 Point of operation safeguarding devices When the effectiveness of the safeguarding device provided is dependent on the safety distance, a stopping performance monitor shall be provided.	***E8.6***
When automatic monitoring of the stopping performance is not available, a periodic test of the stopping performance during the hazardous portion of the cycle shall be conducted.	Automatic end-of-cycle stopping performance monitoring is typically only effective on friction clutch/brake systems since the same components are used for all stops. Hydraulic and servo motor driven machines utilize different components for down and up movements. Monitoring of these components that control hazardous motion is usually not done on a normal machine cycle.
A point of operation device shall conform to one of the following requirements 8.6.1 through 8.6.6.	
When more than one operator is required to operate the press brake each operator shall be safeguarded.	One or more safeguarding devices may be required to adequately protect each operator.
8.6.1 Movable barrier devices **8.6.1.1 Design and construction** **8.6.1.1.1** The type A movable barrier device shall be designed and constructed to enclose the hazard area prior to the start of hazardous motion of the machine and shall be held closed until the machine tool has ceased motion and is at its initial starting position. The device shall open or be opened at the end of the machine cycle in order to reset the system prior to initiation of a subsequent machine cycle.	***E8.6.1.1*** See Figure 4, Annex A.

Standard Requirements	Explanatory Information
8.6.1.1.2 The type B movable barrier device shall be designed and constructed to enclose the hazard area prior to the start of hazardous motion of the machine and shall be held closed until completion of the hazardous portion of the machine cycle. The device shall open at the completion of hazardous motion and shall reset the system prior to the initiation of a subsequent machine cycle.	
8.6.1.1.3 The initiation of the machine cycle shall require: a) the movable barrier device to be in the closed position; b) the cycle initiation means be actuated.	
8.6.1.1.4 Movable barrier devices shall be designed to be capable of returning to the open position should the device encounter an obstruction while enclosing the hazard area.	***E8.6.1.1.4*** In the event that the device detects an obstruction during its closing motion, it should prevent the machine from being actuated, stopping motion before injuring individuals, and should be capable of reopening to allow the obstruction to be removed and to prevent entrapment of the operator.
8.6.1.1.5–A single failure of a component, a subassembly or a module of the movable barrier device that affects the performance of the safety-related functions shall not prevent a normal stop command from being initiated or shall cause an immediate stop command. In the event of a failure, re-initiation of the machine shall be prevented until the failure is corrected or the system or device is manually reset.	***E8.6.1.1.5*** The intention of a manual reset is to encourage the diagnosis of a failed component, subassembly, device or module. A second failure may occur during the diagnostic or troubleshooting process, negating the safety function(s). Additional safeguarding should be used to protect individuals during this process.
In the presence of a failure, repetitive manual reset of the system or device shall not be used for production operation.	See definition for control reliability and Annex C for further information.
8.6.1.1.6 Movable barrier devices shall not in themselves create a hazard to the individuals.	
8.6.1.1.7 The movable barrier device shall be designed and constructed to provide visibility of the hazard area when it is necessary to view the machine operation.	***E8.6.1.1.7*** Where visibility of the operation is required, appropriate materials and color for the device should be selected: a) perforated material or wire mesh should provide adequate open area; b) color should be darker than the area observed to enhance visibility.
8.6.1.2 Installation and operation **8.6.1.2.1** The movable barrier device shall be installed, maintained, adjusted, and operated in accordance with the requirements of this clause.	***E8.6.1.2.1*** The safeguarding supplier's recommendations should be followed for proper operation of the device. The user should direct individuals to immediately report any apparent malfunction or improper operation of the device to a designated person.

Standard Requirements	Explanatory Information
8.6.1.2.2 Movable barrier devices shall be installed and operated such that individuals cannot reach the hazard by reaching over, under, around, or through the device when in the closed position. Device openings shall conform to Table D.1 and Figure D.10 in Annex D.	***E8.6.1.2.2*** Other guards or devices may be used in conjunction with barrier guards to accomplish this requirement.
8.6.1.2.3 Adjustments of the movable barrier device that affect the safety of the operation of the machine shall only be performed by authorized individuals.	
8.6.1.2.4 The interface of the device and the machine control system shall be such that a single failure of a component, a subassembly or a module of the interface that affects the performance of the safety-related functions shall not prevent a normal stop command from being initiated or shall cause an immediate stop command. In the event of a failure, re-initiation of the machine shall be prevented until the failure is corrected or the system or device is manually reset.	***E8.6.1.2.4*** The intention of a manual reset is to encourage the diagnosis of a failed component, subassembly, device or module. A second failure may occur during the diagnostic or troubleshooting process, negating the safety function(s). Additional safeguarding should be used to protect individuals during this process.
In the presence of a failure, repetitive manual reset of the system or device shall not be used for production operation.	See definition for control reliability and Annex C for further information.
8.6.1.2.5 Visibility of the point of operation shall be considered when locating the movable barrier device.	
8.6.2 Presence-sensing safeguarding device **8.6.2.1 Design and construction.** **8.6.2.1.1** The presence-sensing device shall be designed and constructed to create a field which detects the presence of an individual(s).	
8.6.2.1.2 The electrical optical presence-sensing device shall have a minimum object sensitivity such that an obstruction of a same or greater size will always be detected anywhere within its sensing field regardless of the plane of intrusion.	***E8.6.2.1.2*** The presence-sensing device should have a minimum object sensitivity stated by the manufacturer. For example, an electrical optical device may detect an opaque object with a diameter of 30 mm (1¼ in) anywhere in its sensing field but allow an obstruction with a diameter of 25 mm (1 in) to pass undetected at certain points in the field. The user should refer to the supplier's recommendations for testing a presence-sensing device to establish testing procedures before implementing and maintaining PSDI. For an example of such a procedure, see E10.4.3
8.6.2.1.3 Presence-sensing devices that require adjustments to accommodate variations in ambient or operating conditions or that incorporate blanking or muting features shall be designed such that these adjustments or features are capable of being supervised by the user.	***E8.6.2.1.3*** Methods of meeting this requirement include but are not limited to the use of key operated controls or controls located under lockable covers.

Standard Requirements	Explanatory Information
8.6.2.1.4 The presence-sensing device shall incorporate visual means to indicate that the device is detecting the presence of an individual within the effective sensing field of the device.	***E8.6.2.1.4*** A display such as a meter or signal lamp is useful to indicate the degree of penetration as an aid to set-up and shape of the radio frequency (RF) field as well as a separate signal to indicate intrusion resulting in a stop command. Indicator lamps, usually red and green, should be provided to indicate that the device is functioning. If a bypass is provided, see 8.6.2.2.5. Due to the prevalence of color blindness, unambiguous positioning, patterning, labeling, or flashing of the indicators may be an effective method of providing the indication discussed.
8.6.2.1.5 The presence-sensing device shall have a maximum response time that shall not be affected by object sensitivity adjustments or environmental changes.	***E8.6.2.1.5*** The safeguarding supplier should state the maximum total response time, including output devices, of the presence-sensing device.
8.6.2.1.6 The radio frequency (RF) presence-sensing device shall provide means to adjust the sensitivity of the field. The field, once adjusted, shall not decrease in sensitivity below this established level.	
8.6.2.1.7 The electrical optical device shall not be affected by ambient light conditions or by light source decay such that an increase in response time or object sensitivity occurs.	***E8.6.2.1.7*** When the electrical optical device is exposed to signals from other electrical optical devices or to changes in ambient light commonly associated with windows, light fixtures, skylights, bay doors or die lights, the response time or object sensitivity should not be adversely affected.
8.6.2.1.8 A single failure of a component, a subassembly or a module of the presence-sensing device that affects the performance of the safety-related functions shall not prevent a normal stop command from being initiated or shall cause an immediate stop command. In the event of a failure, re-initiation of the press brake shall be prevented until the failure is corrected or the system or device is manually reset.	***E8.6.2.1.8*** The intention of a manual reset is to encourage the diagnosis of a failed component, subassembly, device or module. A second failure may occur during the diagnostic or troubleshooting process, negating the safety function(s). Additional safeguarding should be used to protect individuals during this process.
In the presence of a failure, repetitive manual reset of the system or device shall not be used for production operation.	See definition for control reliability and Annex C for further information.
8.6.2.2 Installation and operation **8.6.2.2.1** The effective sensing field shall be of adequate height, width, and depth so that entry of the individual is detected.	***E8.6.2.2.1*** The presence-sensing device selected should be adequate to prevent the operator or others from reaching over, around, under or through the sensing field into the hazard area. Auxiliary safeguarding may be required in conjunction with the device to accomplish this requirement. See Figure 5, Annex A.

Standard Requirements

8.6.2.2.2 The presence-sensing device (PSD) shall protect individuals from hazards associated with the point of operation by initiating an immediate stop command to the machine control system when the sensing field of the device is interrupted during the hazardous portion of the machine cycle and shall require re-initiation of the normal actuating control prior to the start or continuation of motion of the machine.

When an individual can pass through the sensing field of the PSD, the device or the machine control shall initiate immediate stopping action and shall require that the device or machine control be manually reset before hazardous motion can occur.

The reset device shall be located at the PSD or at a location outside of the hazard area and the reset device shall be located so that it cannot be reached from within the hazard area. Reset shall not occur until verification that the hazard area is clear.

Explanatory Information

E8.6.2.2.2 Various presence-sensing devices employ different sensing and adjustment techniques.

The point at which a device responds to an intrusion may vary. The devices should be located or adjusted such that the device always responds to the intrusion at or prior to the safety distance D_S. See E8.6.2.2.7.

Care should be exercised when installing the device to ensure that it does not detect false signals from other devices in the area.

Usually the electrical optical presence-sensing device is used in a manner that provides a protected zone in front of the primary work area with auxiliary devices or guards used to protect secondary access areas. In some cases, however, mirrors may be used in conjunction with the device to provide two, three, or four-sided protection.

Usually the antenna of a RF presence-sensing device is installed adjacent to the point of operation or other pinch points in such a manner that there is no access to the hazard area except through the sensing field generated by the device. The antenna may enclose one, two, or more sides or areas of the machine tool. Auxiliary safeguarding may be required to accomplish this.

The operator should ensure that no individual is in the hazard area before resetting the device or machine control and initiating hazardous motion. Key lock reset switches located at various positions around the hazard area may be one method of accomplishing this requirement.

See Figures 6 and 7 in Annex A.

Standard Requirements	Explanatory Information
8.6.2.2.3 The interface of the device and the machine control system shall be such that a single failure of a component, a subassembly or a module of the interface that affects the performance of the safety-related functions shall not prevent a normal stop command from being initiated or shall cause an immediate stop command. In the event of a failure, re-initiation of the press brake shall be prevented until the failure is corrected or the system or device is manually reset.	***E8.6.2.2.3*** The intention of a manual reset is to encourage the diagnosis of a failed component, subassembly, device or module. A second failure may occur during the diagnostic or troubleshooting process, negating the safety function(s). Additional safeguarding should be used to protect individuals during this process.
In the presence of a failure, repetitive manual reset of the system or device shall not be used for production operation.	See definition for control reliability and Annex C for further information.
8.6.2.2.4 Muting of the device shall be permitted during the non-hazardous portion of the machine cycle. Muting of the device shall be accomplished such that a single component failure shall not prevent the normal stopping action from taking place. The device, it's interface, or control system shall prevent the initiation of successive normal machine cycles until the failure has been corrected.	***E8.6.2.2.4*** Muting is typically accomplished by interface circuits or auxiliary controls. The muting element should incorporate a similar level of control reliability as the presence-sensing device itself. A simple cam-operated limit switch wired in parallel with the device's output is inadequate, as its failure can remain undetected. Refer to 8.3 and Annex C for a discussion of control reliability.
If the machine has reversing capability where a muting hazard is possible, the control shall include an automatic means so muting is only permitted in the forward direction.	One method of meeting this requirement is by the use of a control circuit interlock on the drive motor starter (forward direction contact) to allow "muting" in the forward direction only, when the starter is energized.
8.6.2.2.5 Bypassing of the device shall be capable of being supervised by the user. Indication that the device is bypassed shall be provided and shall be readily observable by individuals protected by the device. When bypassed, the device, interface or control system shall not indicate any state other than "bypass." When the device is bypassed, other safeguarding must be provided and used.	***E8.6.2.2.5*** Care should be taken to ensure that the operators and other individuals are aware that the device has been bypassed. Due to the prevalence of color blindness, unambiguous positioning, patterning, labeling, or flashing of the indicators may be an effective method of providing the indications discussed
8.6.2.2.6 The RF device shall not be adversely affected by changes around the machine that may alter the sensitivity of the device such that individuals are no longer detected in the sensing field at the proper safety distance.	***E8.6.2.2.6*** The RF device may be affected by changes in the conditions around the machine such as ambient conditions, the placement of parts and tote boxes, grounding conditions of the operator, or the movement of industrial trucks. These changes should not adversely affect the performance of the device.
8.6.2.2.7 The effective sensing field of the presence-sensing device shall be located and fixed at the calculated safe distance (D_s) from the nearest recognized hazard such that individuals cannot reach the hazard before cessation of motion during the hazardous portion of the machine cycle.	***E8.6.2.2.7*** The stopping time includes many factors in addition to the actual stopping time of the machine. The following formula should be used when calculating the safety distance: $D_S = K(T_S+T_C+T_r+Tspm)+D_{pf}$ where: D_S = Minimum safety distance between the device and the nearest point of operation hazard in inches.

Standard Requirements

Explanatory Information

K = Hand speed constant.
NOTE – The value of the hand speed constant, K, has been determined by various studies and although these studies indicate speeds of 1.6 m/sec (63 in/sec) to over 2.5 m/sec (100 in/sec), they are not conclusive determinations. The user should consider all factors, including the physical ability of the operator, when determining the value of K to be used.
T_S = Stop time of the machine measured at the final control element.
T_C = Response time of the control system.
NOTE – T_S and T_C are usually measured by a stop time measurement device.
T_r = Response time of the presence-sensing device and its interface, if any, as stated by the manufacturer or measured by the user.
Tspm = The percentage of increase allowed by the stopping performance monitor for variations in stopping at the normal stopping position applied to the maximum stopping time.
D_{pf} = Added distance due to the penetration factor.

See Annex D for additional information on safety distance.

8.6.2.2.8 The electro-optical device shall not fail to respond to the presence of individuals due to a reflective object or workpiece in the vicinity of the device.

E8.6.2.2.8 Some examples of reflective objects include but are not limited to:
a) machine surfaces;
b) tooling;
c) workpieces;
d) hand tools;
e) auxiliary equipment;
f) work holding tables and fixtures.

8.6.3 Pull-back safeguarding device
A pull-back device, if used, shall meet the following requirements:

E8.6.3
The use of two-hand controls or trips or other devices can be an effective complement to this safeguard, to ensure that the operator's hands are out of the point-of-operation prior to the initiation of the press brake cycle (stroke). See figure 8, Annex A.

a) Be connected to and operated only by the press brake ram or its attached die.
b) The hand attachments, including wristlets, snaps and cables, shall be used in a manner prescribed by the supplier.
c) Each device in use shall be visually inspected and checked for proper adjustment at the start of each operator shift, following a new die set-up, when operators are changed and after any repair or maintenance that can affect the performance of the pull-back.

b) The supplier should provide instructions with the pull-back device for its proper installation, operation and maintenance.
c) Proper adjustment of the pull-back device requires consideration of the orientation of the hand and the workpiece in place or with the workpiece out of position, as well as the height of the workpiece passing over the die during withdrawal of the workpiece, which has the effect of reducing hand clearance. Due to the adjustability of pull-back devices,

Standard Requirements	Explanatory Information
	care should be taken to ensure the continued supervision and instruction in the proper use of this device.
d) Necessary maintenance or repair, or both, shall be performed and completed before the press brake production system is operated.	d) The supplier's installation and maintenance instructions should be used to set up a maintenance and repair program. Records can be useful in establishing and maintaining a maintenance and inspection program.
e) Fasteners, pins, and other components used to secure and maintain the setting of the device shall be applied in such a manner as to prevent loosening, slipping, or failure during use. f) The pulling or holding members or cables and the hand and wrist attachments of the device shall be of a substantial material that will resist deterioration from environmental conditions. g) Die or tooling set-ups that have bolts, nuts, studs stops, blow-off tubes, or other objects that protrude from the point-of-operation shall be protected so that they shall not interfere with the normal pulling action of the hand attachments.	
h) If work gloves are worn by the operator, the user shall ensure that the gloves are worn over the hand attachments and worn when the adjustment is checked.	h) Gloves should be worn over the hand attachments so that if a glove is trapped in the press or tooling, it will not prevent the pull-back device from removing the operator's hand from the point-of-operation.
8.6.4 Restraint safeguarding device (holdout) A restraint device, if used, shall meet the following requirements: a) Hand and wrist attachments shall be anchored and adjusted in such a way that the operator is restrained from reaching into the point-of-operation at all times; b) Each device in use shall be visually inspected and checked for proper adjustment at the start of each operator shift, following a new die set-up, and when operators are changed; c) Fasteners, pins, and other components used to secure and maintain the setting and adjustment of the restraint device (holdout) shall be applied in such a manner as to prevent loosening, slipping, or failure during use; d) Holding members or cables and the hand and wrist attachments of the device shall be of a substantial material that will resist deterioration from environmental conditions.	***E8.6.4*** The supplier should provide instructions with the restraint device for its proper installation and operation and to establish guidelines for its proper care. See Figures 9 and 10 in Annex A.
8.6.5 Two-hand control safeguarding device **8.6.5.1 Design and construction** **8.6.5.1.1** The two-hand control device shall have individual hand controls arranged by design, construction, or separation to require the use of both hand controls for actuation.	***E8.6.5.1.1*** See Figures 11 and 12 in Annex A.

Standard Requirements	Explanatory Information
8.6.5.1.2 The two-hand control device shall meet the requirements of ANSI / NFPA 79 and shall be a type 3 control.	***E8.6.5.1.2*** ANSI / NFPA 79 requires the manufacturer of the machine to specify the time limit. Other standards require that the time limit be 500 milliseconds or less.
8.6.5.1.3 If more than one operator is to be safeguarded by the use of two-hand controls, each operator shall have individual hand controls. The selection of the two-hand control shall be capable of being supervised by the user. The control system shall be designed and constructed so as to prevent cycling of the machine if all the operator's stations are deselected.	
8.6.5.1.4 A single failure of a component, a subassembly or a module of the two-hand control device that affects the performance of the safety-related functions shall not prevent a normal stop command from being initiated or shall cause an immediate stop command. In the event of a failure, re-initiation of the press brake shall be prevented until the failure is corrected or the system or device is manually reset. In the presence of a failure, repetitive manual reset of the system or device shall not be used for production operation.	***E8.6.5.1.4*** The intention of a manual reset is to encourage the diagnosis of a failed component, subassembly, device or module. A second failure may occur during the diagnostic or troubleshooting process, negating the safety function(s). Additional safeguarding should be used to protect individuals during this process. See definition for control reliability and Annex C for further information.
8.6.5.2 Installation and operation **8.6.5.2.1** A two-hand operating lever, trip, or control device shall be installed, operated, and maintained in accordance with this standard.	
8.6.5.2.2 The device shall be located at a distance from the nearest hazard such that the operator cannot reach the hazard before cessation of hazardous motion. The two-hand operating lever, trip, or control device shall require concurrent actuation of both of the operating levers or hand controls to initiate a machine cycle.	***E8.6.5.2.2*** The stopping time includes many factors in addition to the actual stopping time of the machine (see Annex D for additional information on safety distance).
8.6.5.2.3 The two-hand control device shall require the concurrent actuation of the operator's hand controls during the hazardous portion of the machine cycle such that the operator cannot reach the hazard before the hazardous motion has ceased.	

Standard Requirements	Explanatory Information
8.6.5.2.4 The interface of the device and the machine control system shall be such that a single failure of a component, a subassembly or a module of the interface that affects the performance of the safety-related functions shall not prevent a normal stop command from being initiated or shall cause an immediate stop command. In the event of a failure, re-initiation of the press brake shall be prevented until the failure is corrected or the system or device is manually reset. In the presence of a failure, repetitive manual reset of the system or device shall not be used for production operation.	***E8.6.5.2.4*** The intention of a manual reset is to encourage the diagnosis of a failed component, subassembly, device or module. A second failure may occur during the diagnostic or troubleshooting process, negating the safety function(s). Additional safeguarding should be used to protect individuals during this process. See definition for control reliability and Annex C for further information.
8.6.6 Single control safeguarding device Actuating controls used for single control safeguarding devices shall be located at a safe distance.	***E8.6.6*** The actuating controls may be, but are not limited to: • one-hand control; • foot control. Actuating controls that are easily moved closer than the safe distance, or not securely fixed at the safe distance cannot meet this safeguarding requirement. A single control safeguarding device protects only the individual operating the actuating control. See Annex D for additional information on safety distance.
Components, subassemblies or modules of the control, its interface or the machine control system shall meet the requirements of 8.3. In a workpiece bending operation requiring more than one operator (helper), separate single control safeguarding devices shall be provided for each operator (helper). The single control safeguarding device shall be located, installed, used and maintained by authorized individuals.	
8.7 Safe distance safeguarding This method of safeguarding only applies to bending operations on press brake production systems. While guards or safeguarding devices are the primary employee protection measures, due to manufacturing constraints determined by the user, safeguarding by means of safe distance safeguarding is acceptable when the following conditions are met: 1) The safe distance for each job set-up shall be determined;	***E8.7*** See Figure 15, Annex A. 1) Factors that affect the determination of the safe distance may include but are not limited to: a) workpiece size; b) machine speed; c) die shape/size; d) backgage fingers; e) human factors.

Standard Requirements	Explanatory Information
	Safe distances of 100 to 250 mm (4 to 10 in) are required by some regulatory agencies. The user should justify the safe distance used.
	When the workpiece size or shape is such that it would require the operator to place his/her fingers closer to the point of operation than the safe distance, hand tools or fixtures may be required to perform these operations.
	Awareness barriers may be used to assist the operator in maintaining the safe distance. Care should be taken to ensure that the awareness barrier does not create additional hazards. See Figure 3, Annex A.
2) When safe distance safeguarding is used, a safety program which includes work procedures, training and re-training, and supervision to ensure the proper use of this method shall be established;	2) Operator training and re-training is essential for the proper use of safe distance safeguarding. See clause 9 for the requirements for training and supervision.
3) The workpieces being fabricated are primarily unique and are produced in small quantities; and	3) Safe distance safeguarding may be used when a few parts are being fabricated on an infrequent basis. This type of work is normally performed in a job or model shop. The user should justify the use of safe distance safeguarding, by taking into account the following: a) operators independently accomplish frequent die set-up and adjustments as the tasks require; b) high volume rates of production forming are not anticipated; c) the workpieces being fabricated are primarily unique, small quantity runs, which are being developed and produced in close coordination with engineering or the customer.
4) The operator shall hold and support the workpiece by the use of both hands no closer than the minimum safe distance. If both hands are not used to hold the workpiece, additional safeguarding shall be provided to protect the free hand. If other individuals are exposed to the point of operation hazard, safeguarding shall be provided for those individuals.	4) See 8.1.4.
5) When loading or unloading of the workpiece would require the operator(s) hands to be closer than the safe distance, hand tools shall be used.	5) See Figures 13 and 14 in Annex A.
6) When material position gages are used, they shall be of sufficient height and size or shape to prevent slipping of the	6) Care should be exercised when using automatic backgaging systems to ensure that

Standard Requirements	Explanatory Information
material past the gages. Positioning of the gage shall be such that the operator cannot inadvertently place any part of the body closer than the safe distance.	the backgage is at the expected position. See Figure 1, Annex A.
8.8 Auxiliary safety aids 1) Workpiece supporting devices or magnetic material position gages shall be provided where necessary to permit the operator to remove his hands from the workpiece during the closing of the cycle (stroke) when the safeguarding device requires the operator's hands to be removed from the workpiece.	***E8.8*** See Figure 1. This T Bar type gage is preferred for use. It is especially suited for supporting workpieces with a long leg to the rear of the die space. See also, Figure 15, Annex A.
2) When a hand bar is provided on a press brake, it should be mounted at a convenient height on the ram or press brake frame.	2) The hand bar affords an assist to minimize the possibility of operating personnel reaching or falling into the point of operation. For large workpieces, a hand bar sometimes creates a pinching hazard by the forming of the sheet or the risk of the arms being struck by the sheet during bending. Removal of the bar to eliminate these hazards is sometimes necessary. See also, Figure 16, Annex A.
9 Set-up, operation and maintenance The user shall be responsible for the requirements of this clause.	
9.1 Set-up **9.1.1 Die design** Dies and operation methods designed to control or eliminate hazards to operating personnel shall be used. Where the design of the die does not eliminate hazards associated with the use of the die, safeguarding in accordance with clause 8 shall be used.	
9.1.2 Die handling Die handling operations and procedures shall be configured for ease of handling during installation into and removal from the press brake.	
9.1.3 Die setting Die setting operations and procedures shall conform to the following requirements:	***E9.1.3*** The length of the die selected to perform a bending operation should approximate the length of the bend on the workpiece.
1) Use general- and special-purpose dies designed and constructed to eliminate hazards to operating personnel.	1) Die weights must be known and indicated on all large general- and special-purpose dies so that handling equipment or operating personnel will not be subjected to overloading or injury.
2) Special-purpose dies shall be mounted on a bed or ram, or both, by using screw fastenings or clamps, or by the conventional die-clamping method.	2) When using screw fastenings or clamps, the bed or ram, or both, is usually equipped with flanges that increase the front-to-back width of the bed or ram. These flanges can be of the permanent or removable type. When conventional die clamps are used, additional brackets and braces may

Standard Requirements	Explanatory Information
	be required to mount the tooling.
9.1.3.1 Die setter information Individuals responsible for setting dies shall be provided with necessary information, including but not limited to: • rated press brake capacity requirements for the die; • weight of the upper die and other ram attachments required for the job set-up, when needed for setting counterbalance air pressure; • total die weight; • die space. The user shall provide and enforce the use of a hand tool for the purpose of freeing or removing stuck work or scrap pieces from the die, to avoid requiring the operator to place his hands or fingers within the point of operation.	***E9.1.3.1*** Information required for the die setters to properly perform their tasks may be stamped on the face of the die or maintained in a file that is readily available to die setters. Additional information important for setting some dies may include: • minimum stroke requirements; • minimum bed length.
9.1.3.2 Die setting procedures 1) Establish a die-setting procedure using control devices or safeguarding means to protect the die setter(s) from the hazards associated with the die setting process; 2) Counterbalance pressure settings, if used, shall be adjusted in accordance with the die requirements; 3) Newly set dies shall be safeguarded in accordance with clause 8 prior to being placed into productive operation; 4) Individuals shall not reach through or into the point of operation for die removal or installation unless the drive motor is off and the ram is blocked; 5) Individuals shall not reach through or into the point of operation for backgage adjustment unless the drive motor is off and the ram is blocked. EXCEPTION to (4) and (5) - blocking is not required on up-acting machines.	***E9.1.3.2*** Generally the dies should be in a closed position when installing or removing longer (large) length dies.
9.1.4 Die fastening Die fastening provisions shall conform to the following requirements: 1) Both the upper and lower die sections shall have provisions for secure mounting; 2) Fluid powered die clamps, if used, shall have the capability of holding the upper and lower die in the clamped position throughout the ram cycle (stroke).	***E9.1.4*** 2) Consideration should be given to all force vectors that can be applied to the clamps by the tooling so that dies do not move during the cycle (stroke) of the press brake.
9.1.5 Die adjustment, cleaning or repair When it is necessary to place hands or other body parts into	***E9.1.5***

Standard Requirements	Explanatory Information
the point of operation to repair the die(s) in the press brake, or for adjustment and cleaning which is not integral to the production process, means shall be provided to prevent the initiation of hazardous movement.	
To meet this requirement, the following procedures shall be followed:	
1) The press brake drive motor shall be off and the clutch/brake control shall be deactivated;	
2) Safety blocks or other die/ram support means shall be designed, constructed and installed in accordance with ANSI B11.19.	2) Ram counterbalance systems should not be used as a die/ram safety means. Electrical interlocking of the safety block or other die/ram support means is recommended so that the control and drive motor circuits are automatically de-energized when safety blocks are removed from their storage locations.
3) Manually installed safety blocks shall not be utilized until all energy sources are off and flywheels, if used, are stopped.	3) Electrically interlocked, automatically operated safety blocks or die/ram support means may be operated without stopping the flywheel or removing energy sources.
	NOTE - If a press brake is operated with a safety block in place and the press brake is cycled (stroked), the safety block itself becomes a significant hazard to individuals in the vicinity of the press brake; operating personnel should be trained accordingly (see 9.2.3).
9.1.6 Die tryout Individuals performing die-tryout operations shall be safeguarded in accordance with clause 8.4.	
9.2 Operation This section sets forth requirements for safety of individuals in the use of press brakes. Operation is considered to mean the tooling installed, the material position gages adjusted, proper die height adjustment for workpiece operation, and the loading, bending, and unloading of workpiece components that are typically performed utilizing press brakes.	***E9.2*** The breakdown of responsibilities as described in this section should not be interpreted as individual job descriptions, as it is not unusual for one individual to be assigned to more than one of these responsibilities.
Stop controls shall be readily accessible to all operators, as required by the press brake production system. See also, 6.1.3.1.	
9.2.1 The press brake operator shall be responsible for observing the following, except for those tasks which the user has delegated to others:	***E9.2.1*** See Figure 16, Annex A.
1) The operator(s) shall be trained in the correct method to hold the workpiece to prevent injury caused by a hazard between the workpiece and the machine or its attachments during bending;	
2) The press brake shall be made inoperable to unauthorized individuals when the machine is unattended.	2) The ram (slide, beam etc.) should be down and the machine made inoperable by removing or disabling the actuating control. Some

Standard Requirements	Explanatory Information
	examples include, but are not limited to, the following: a) Removing the mechanical foot pedal, or locking the treadle linkage mechanism; b) Manually locking the foot control mechanism; c) Switching the cycling (stroking) control selector used for activation to OFF; d) Activating the Emergency Stop Control; e) Turning off the press brake at the main disconnect switch.
3) Hand tools a) Hand tools do not provide point-of-operation safeguarding and shall not be used to meet the requirements of clause 8; b) The materials used in the design and construction of hand tools shall not shatter in the event of involvement with the machine or its tooling. They shall be designed and constructed such that they do not, in themselves, create a hazard to an individual when used.	3) Hand tools a) Hand-feeding tools are intended for placing and removing materials in and from the press brake; b) The use of hand-feeding tools should prevent the need for the operator to place hands or fingers within the point-of-operation. However, these tools may not prevent the operator from inadvertently placing hands or fingers within the point of operation. Therefore, a guard or device should be used for protection; c) Materials such as aluminum or other material softer than the machine tooling, fixtures, or other components will satisfy this requirement; d) Hand tools should be designed with human factors engineering (ergonomics) principles to minimize fatigue and stress to the hand, wrist, arm, and shoulder. See Figure 13, Annex A.
4) The user shall establish a procedure for safe removal of jammed material or workpieces. When guards or safeguarding devices are unavailable and the machine is operational, hand tools shall be provided and their use enforced for freeing and removing material, workpieces, or scrap stuck in the die. The handles on these tools shall be of sufficient length so that individuals need not reach into the point of operation for such purposes.	4) Procedures should include but not be limited to: • Lockout/tagout procedures; • Die/ram blocking; • Use of hand tools; • Alternate safeguarding; guards and devices; • Training.
9.2.2 Helper The user shall establish and assign responsibilities to the helper, who shall be protected from the hazards at the point of operation by safeguarding, as listed in clause 8.	***E9.2.2*** If the helper is exposed to point of operation hazards, the helper should have his/her own set of operating controls.
9.2.3 Training The user shall establish a training program that ensures the following:	***E9.2.3*** The user should refer to the supplier's recommendations when establishing a training program. It is recommended that the training of

Standard Requirements	Explanatory Information
1) Training shall ensure that individuals associated with press brake production systems are properly trained in safe working procedures and are qualified to perform the functions to which they are assigned.	individuals be documented. 1) Examples of training program elements include but are not limited to: a) A description of the assigned task; b) The function of operator controls to be encountered in performing the assigned task; c) The hazards associated with the assigned task; d) The hazards associated with the improper use of or the failure to use the means of safeguarding provided; e) The designated method of feeding; f) Any requirements for the use of hand tools in the production process (see also 9.3.4); g) The designated method of safeguarding; h) The methods of function-testing or otherwise assuring the proper function of safeguarding.
2) All operators shall be instructed in the operation of the press brake production system. Instructions shall include the following requirements: a) The user shall instruct the operator in the proper method of operation for each production set-up before the press brake production system is placed into production. b) The user shall instruct the operator in the proper use of the safeguarding for each task being performed on the press brake production system. c) The user shall require that all operators demonstrate their knowledge of the press brake production system. d) The user shall instruct the operator of the importance of immediately reporting to the proper supervisor any condition concerning the press brake or workpiece operation that may affect the safety of individuals.	
3) All die setters shall be instructed in the proper procedures for selecting, inspecting and installing dies appropriate to the operations.	3) Dies vary in size, complexity, and intended use. Basic principles in the setting of all types of dies should be included in a die-setter training program, regardless of the classification to which die-setting responsibility is assigned (i.e., set-up and adjuster, maintainer, die setter, production operator, etc.).
4) Maintenance personnel shall be trained in safe working procedures for inspecting and maintaining press brake production systems.	4) The user should make supplier's instructions and recommendations readily available to maintenance personnel.
5) Supervisors shall be trained in safe working procedures for set-up, operation and maintenance of press brake production systems.	
6) Individuals shall be trained, as required by assigned functions, in the safe working procedures for lockout/tagout of hazardous energy sources in accordance with 29 CFR	6) Training should include, but not be limited to: • Proper safeguarding means and methods;

Standard Requirements	Explanatory Information
1910.147 & 1910.333.	• Presetting inspection and verification of specifications (e.g., required tonnage, stroke); • Removal, transport and storage of dies; • Orientation and installation of replacement dies; • die tryout; • system operation. See also, ANSI Z244.1

9.3 Maintenance

9.3.1 Inspection and maintenance records

Establish and follow a program of periodic and regular inspections of the press brake to ensure that all of the parts, auxiliary equipment, and safeguards are in safe operating condition and adjustment. The user shall maintain records of these inspections and the maintenance work performed.

9.3.2 Pre-inspection shutdown procedure

Establish and follow a safe procedure before allowing a press brake to be inspected or maintained. Following the inspection or maintenance, the machine must be restored to the predetermined operating condition.

The user shall establish and follow a lockout/tagout procedure as required by 29 CFR 1910.147 & 1910.333.

9.3.3 Work area

E9.3.3
Sufficient clearance must be provided for personnel, ladder positioning, and any other necessary maintenance equipment.

Provide an adequate work area around press brakes to permit safe maintenance practices.

Provide an adequate work area around the press brake production system to permit safe operation, maintenance and material handling. The work area shall be kept free from materials or substances, which may create a slip, trip or fall hazard.

The point-of-operation or die area shall be kept clear of all material or items other than the workpiece being formed.

Standard Requirements	Explanatory Information
10 Additional requirements for PSDI operation	
10.1 General PSDI shall only be incorporated on press brakes that meet the requirements of this standard.	
10.2 "Pass-through" hazards Press brake production systems with a configuration that would allow an individual to enter, pass through, and become clear of the presence–sensing device sensing field shall not be operated in the PSDI mode of operation.	***E10.2*** Examples to meet this requirement can include, but are not limited to: • mechanical barriers; • extended sensing field(s) of the presence-sensing device such as horizontal sensing segments.
10.3 Multiple operators and multiple PSDI actuating controls Where more than one presence-sensing device actuating control is used on a press brake in the PSDI mode, the control system shall require that the selected number of breaks for each presence-sensing device occur to initiate a cycle.	***E10.3*** This does not apply to presence-sensing devices used only for supplementary safeguarding.
10.4 Presence-sensing device used for PSDI **10.4.1** PSDI shall be implemented only by use of presence-sensing devices, which meet the requirements of 8.6.2.	***E10.4.1*** Although light curtains are typically used for PSDI, alternatives to light curtains may be used when the user can demonstrate, through tests and analysis by the user or device supplier, that the alternative: a) is as safe as the light curtain; b) meets the conditions of this clause; c) has the same long term reliability as light curtains; and d) can be integrated into the entire safety system.
10.4.2 The area protected by the presence-sensing device used to initiate cycles in the PSDI mode shall be in clear view of the operator from the operating position.	***E10.4.2*** The operator should be able to view the entire area of the sensing field so that the operator can warn others not to intrude into the sensing field, which could cause unintended tripping of the press. This may be of particular concern where a PSDI actuating device is used to cover more than one side of the press.
If more than one presence-sensing device is used with multiple operators, each operator shall have a clear view of the area protected by their presence-sensing device when in the PSDI mode.	A presence-sensing device used in the PSDI mode may have multiple operators entering the sensing field.

Standard Requirements

10.4.3 Light curtains used for PSDI operation shall have minimum object sensitivity not to exceed 32 mm (1¼ in). Where light curtain object sensitivity is user–adjustable, either discretely or continuously, design features shall limit the minimum object sensitivity adjustment not to exceed 32 mm (1¼ in).

Explanatory Information

E10.4.3 The user should refer to the supplier's recommendations for testing a presence-sensing device to establish testing procedures before implementing and maintaining PSDI.

An example of such a procedure might be:

> Using a test probe sized to the minimum object sensitivity, insert the probe perpendicularly into the sensing field at an upper corner, move the probe across the sensing field to the other upper corner. Move the probe downward to the lower corner, then across to the other corner. Move the probe upward to the starting point. After completing the 'box' shape, move the probe diagonally across the field to the opposite corner. Move the probe up, then bring it diagonally across to the opposite lower corner.

The above test, using a properly sized probe, should cause the presence-sensing device to generate a stop signal. This signal should be present during the entire pattern.

10.4.4 Blanking of the sensing field shall be permitted in the PSDI mode provided it meets the requirements of 10.4.3.

If fixed blanking is used and the minimum object sensitivity exceeds 32 mm (1¼ in), then the blanked area shall be completely obstructed.

E10.4.4 The use of barrier guards is one method of meeting this requirement.

Standard Requirements

10.5 Supplemental guards or devices

Supplemental guards or devices shall be used to protect all areas of access to the point of operation that are unprotected by the PSDI presence-sensing device.

10.6 Hand tools

Where tools are used for feeding, removal of scrap, lubrication of parts, or removal of workpieces that stick on the die in PSDI operations, the hand tool selected shall be such that it does not create a break sequence until it is withdrawn from the plane of the PSD.

10.7 Inspection and maintenance

The user shall establish a procedure for inspection and maintenance based upon the specific application of use and the supplier's instructions and recommendations.

10.8 Operator Training

Operator training shall be provided to the employee before the employee initially operates the press brake and as needed to maintain competence. It shall include instruction and training specific to PSDI operations. Refer to 9.2.3 for additional training requirements.

Explanatory Information

E10.5

Supplemental guards or devices may include barrier guards, additional light curtains, or other devices meeting the requirements in clause 8.

E10.6

One way of meeting this requirement is to select a hand tool with a tool handle extension having a cross section equal to or greater than the minimum object sensitivity of the presence-sensing device(s) used to initiate a press brake cycle.

E10.7

Inspections may be made on a periodic and regular basis, and include but not be limited to the following:

a) A check be performed using the test tool according to the established test procedure to determine that the presence-sensing device used for PSDI is operational.
b) The safety distance be checked for compliance with clause 8.
c) A check be made to determine that all supplemental safeguarding is in place. Where presence-sensing devices are used for supplemental safeguarding, a check for proper operation shall be performed using the test tool according to the established test procedures.
d) A check be made to assure that the barriers or supplemental presence-sensing devices required by clauses 8 and 10.5 are operating properly.
e) When any check of the press determines that a condition of noncompliance, improper adjustment, or failure exists, the press may not be operated until the condition has been corrected by adjustment, replacement, or repair.

Annex A - Figures
(Informative)

NOTE – These figures are intended to clearly and simplistically illustrate the particular concepts shown. They are not sophisticated or complicated line drawings showing all details of all features.

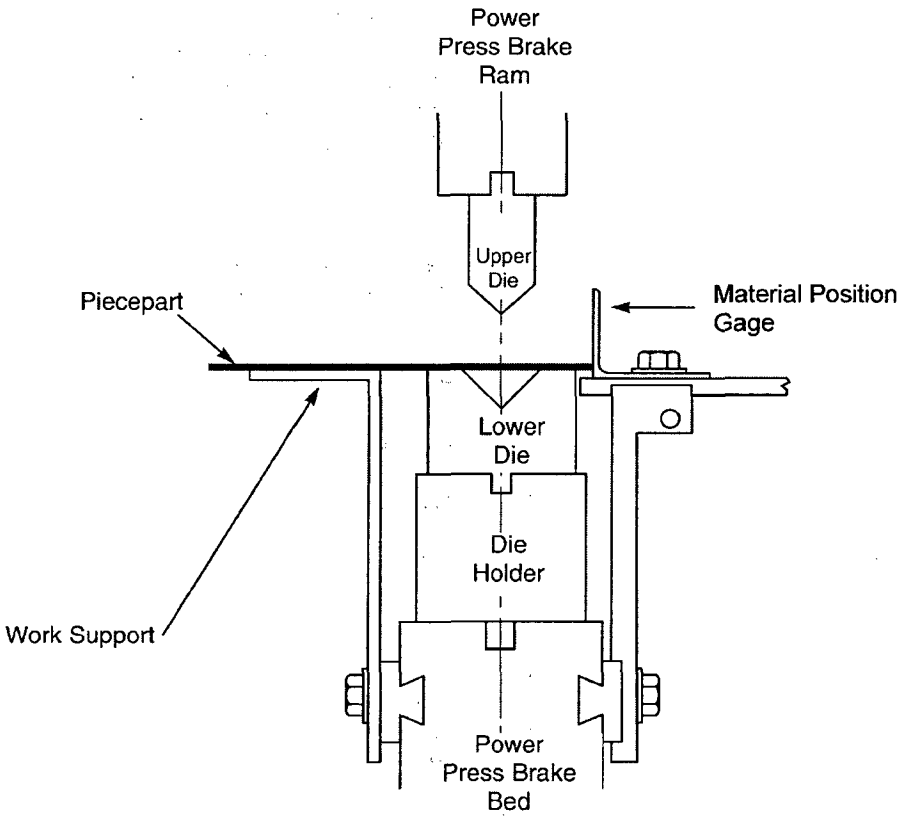


Figure 1
Example of Material Position Gage and Work Support

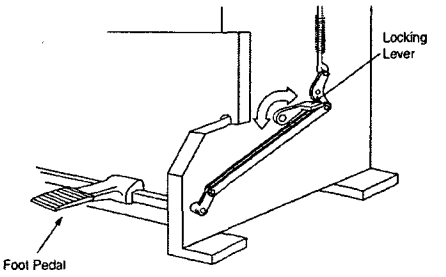


Figure 2
Example of a Removable and Adjustable Mechanical Foot Pedal and Locking Lever

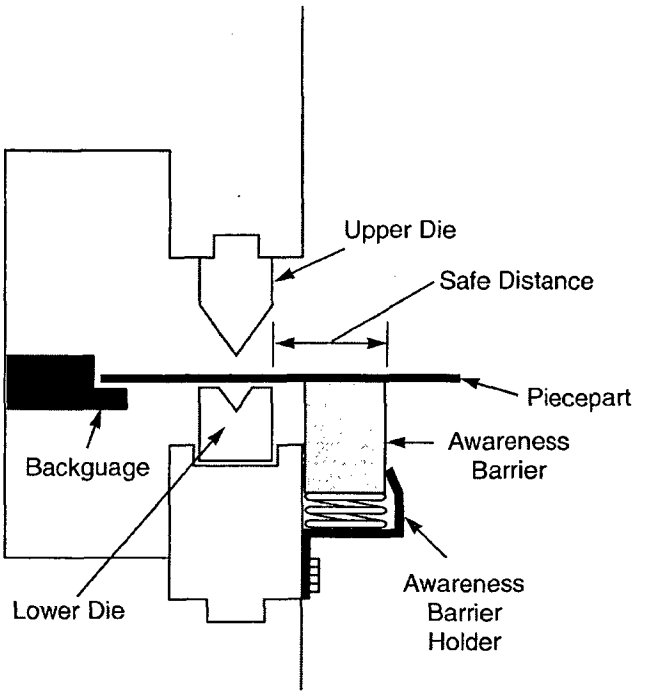


Figure 3
Example of Awareness Barrier with Safe Distance Safeguarding

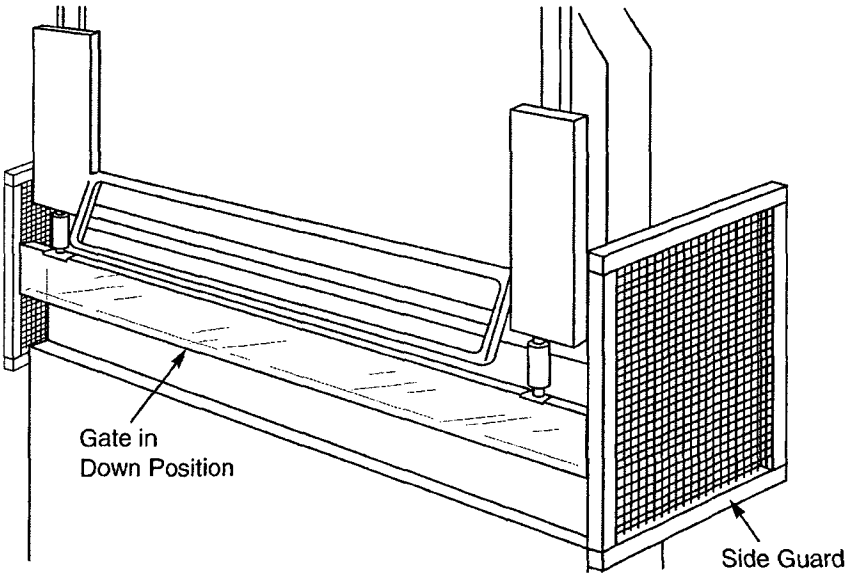


Figure 4
Example of a Movable Barrier Device

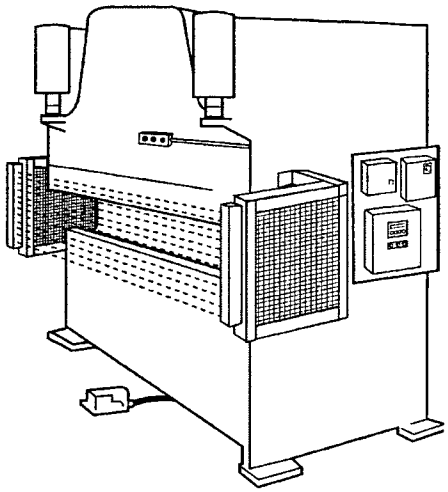


Figure 5
Example of Presence-sensing Devices

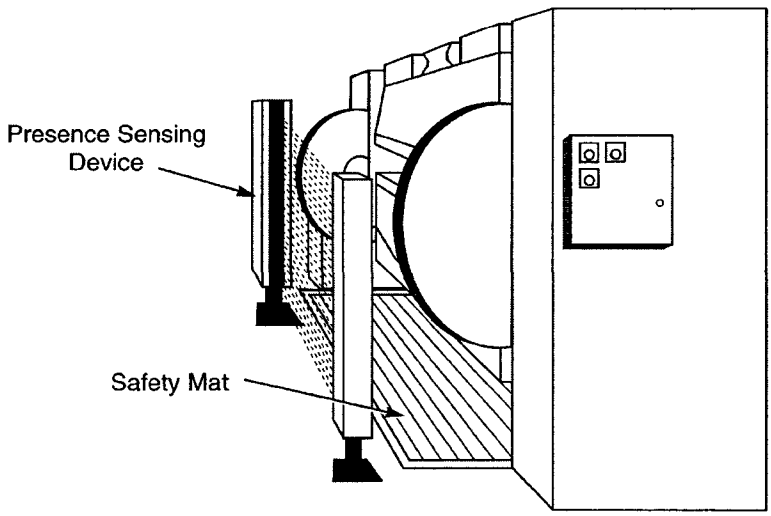


Figure 6
Example of Vertically Mounted Presence-sensing Device and Safety Mat Providing Pass-Through Protection

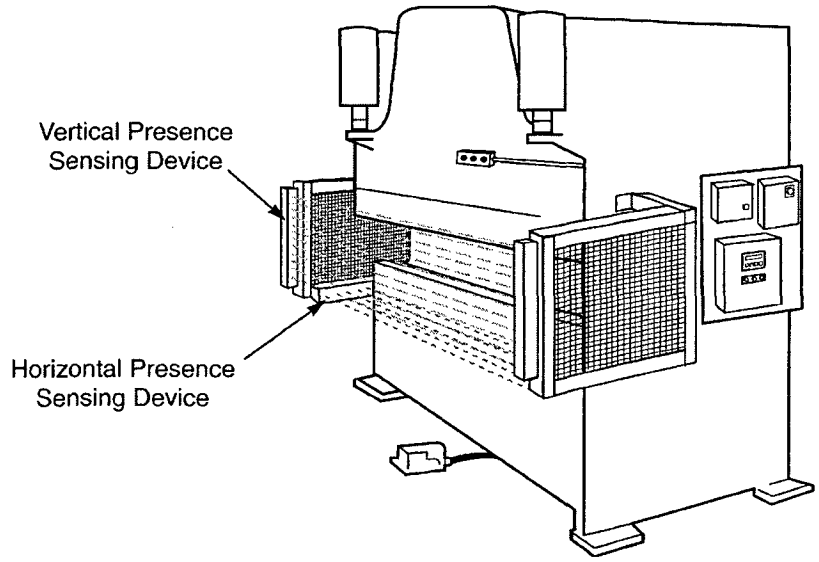


Figure 7
Example of Horizontal and Vertical Presence-sensing Devices

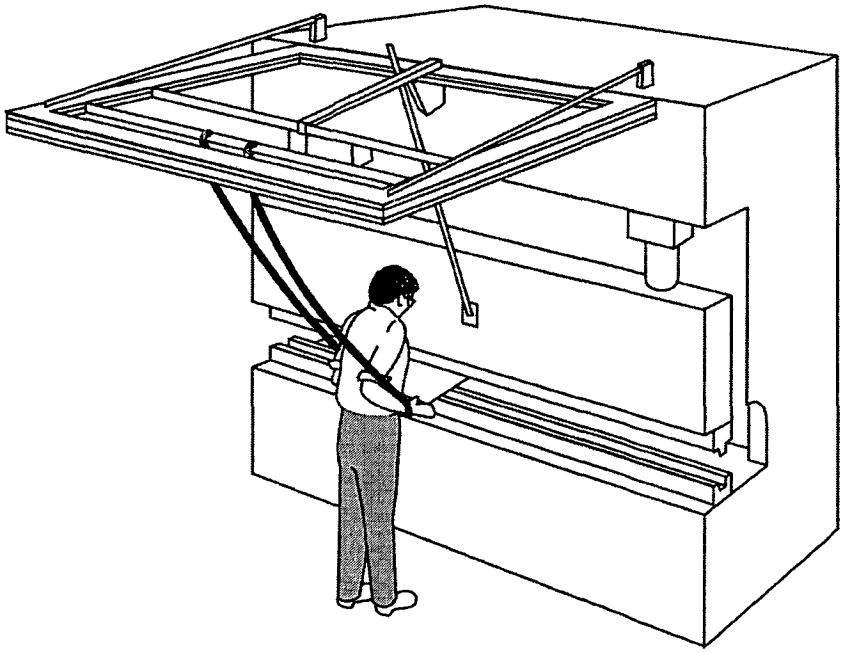


Figure 8
Example of a Pullback Device

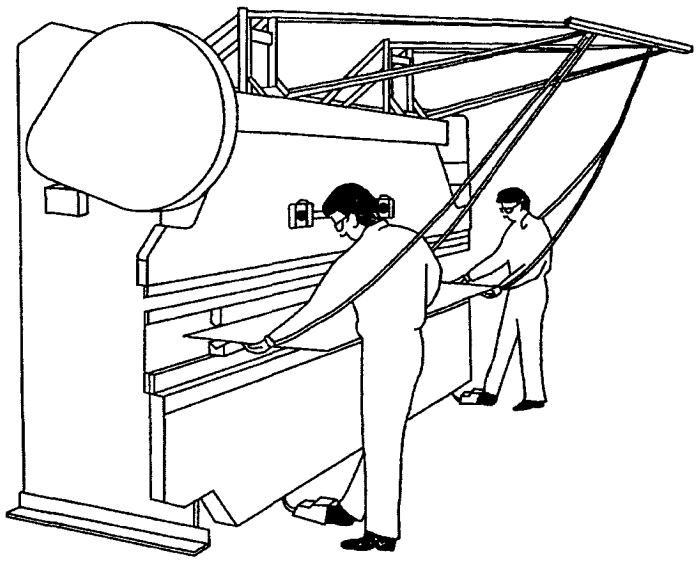


Figure 9
Example of Restraints with Two Operators

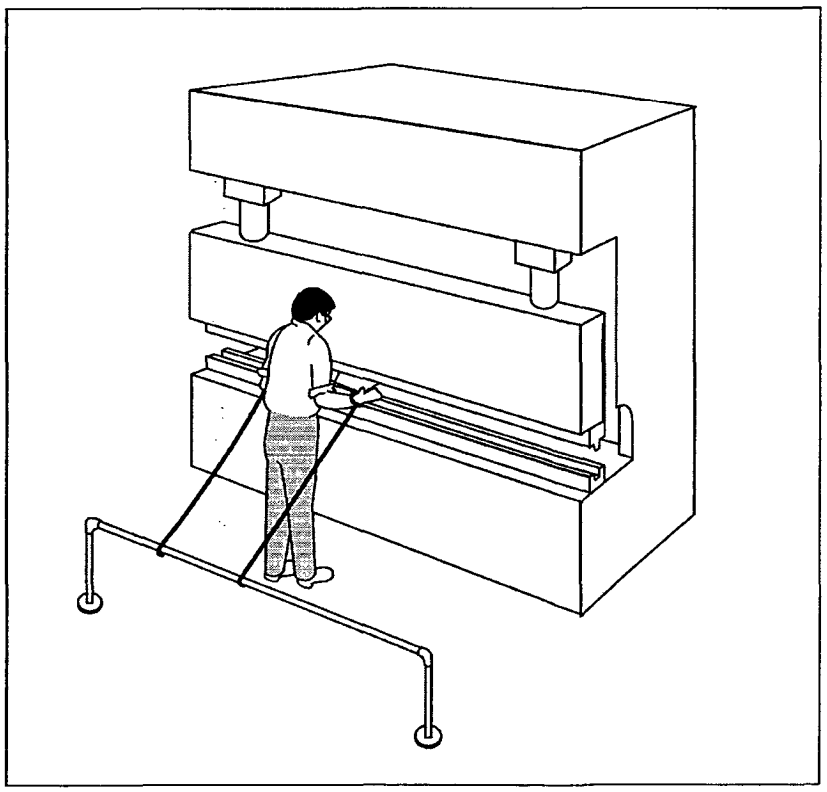


Figure 10
Example of a Restraint

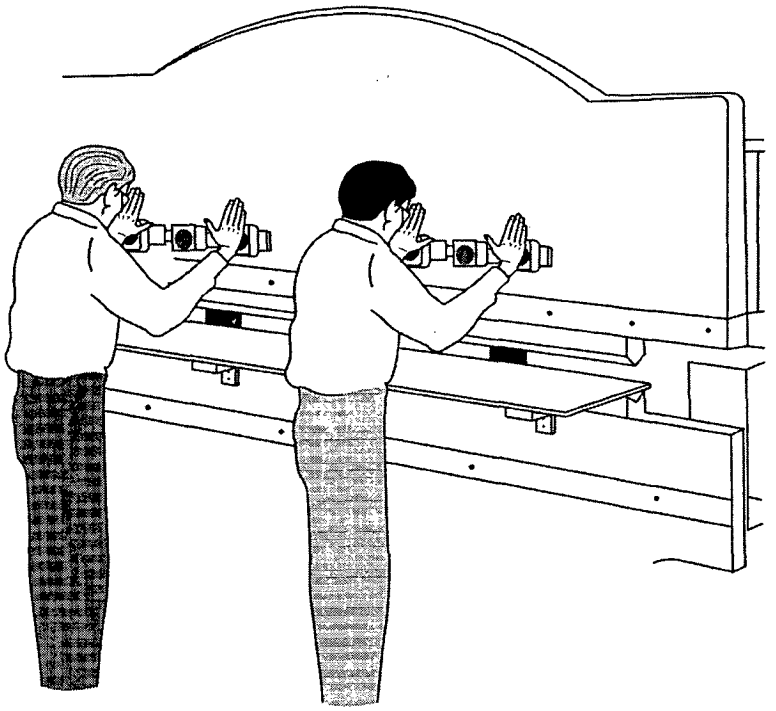


Figure 11
Example of two Operators with Two-Hand Control Mounted to Machine

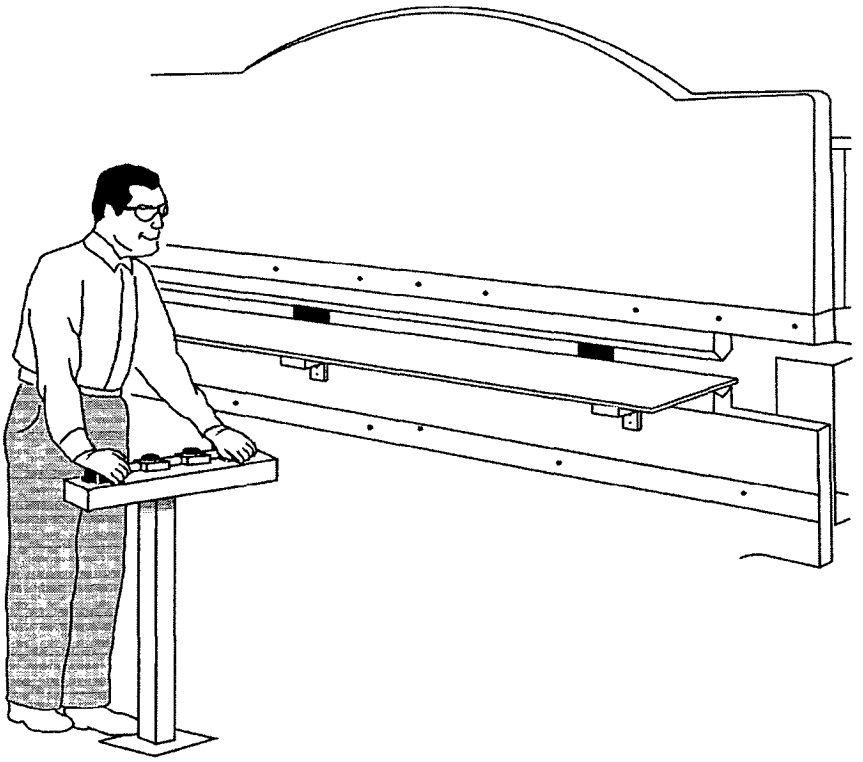


Figure 12
Example of Two-Hand Control Mounted on Pedestal

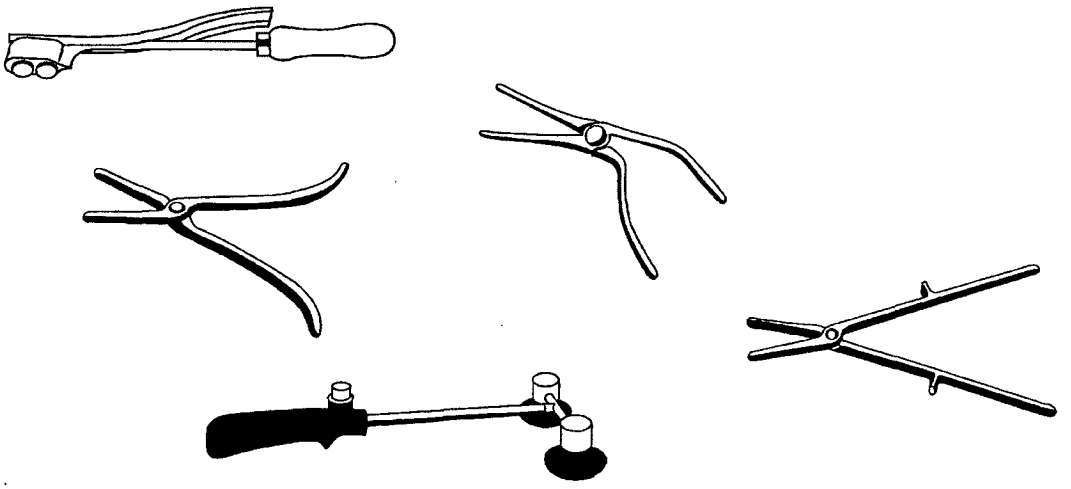


Figure 13
Examples of Hand-Feeding Tools

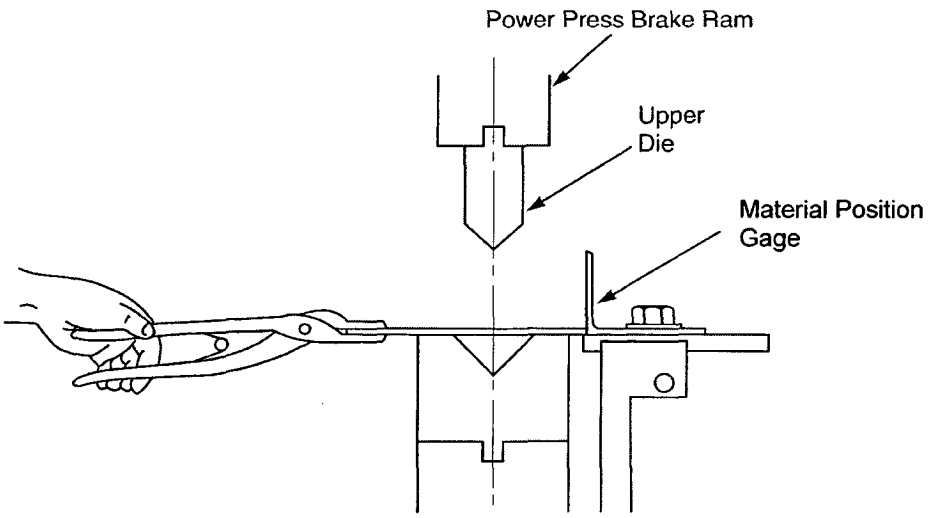


Figure 14
Example of Hand Tool Feeding

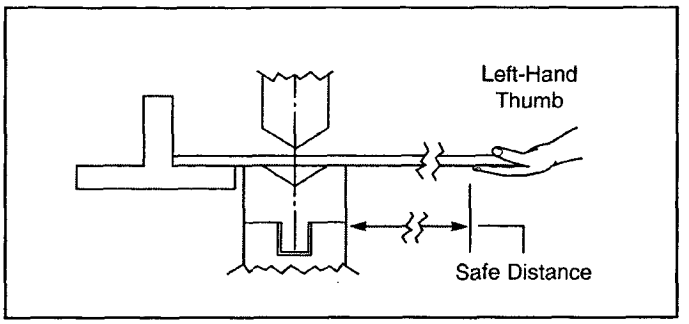


Figure 15
Example of Safe-Distance Safeguarding

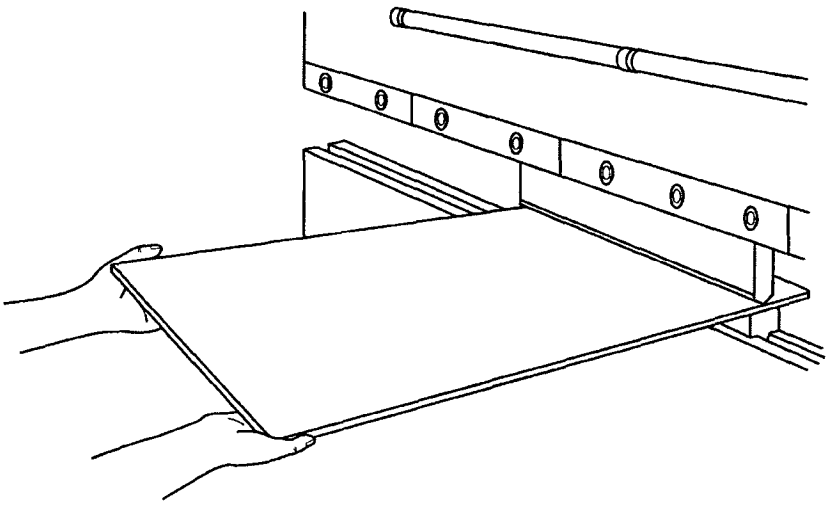


Figure 16
Proper Holding of Workpiece

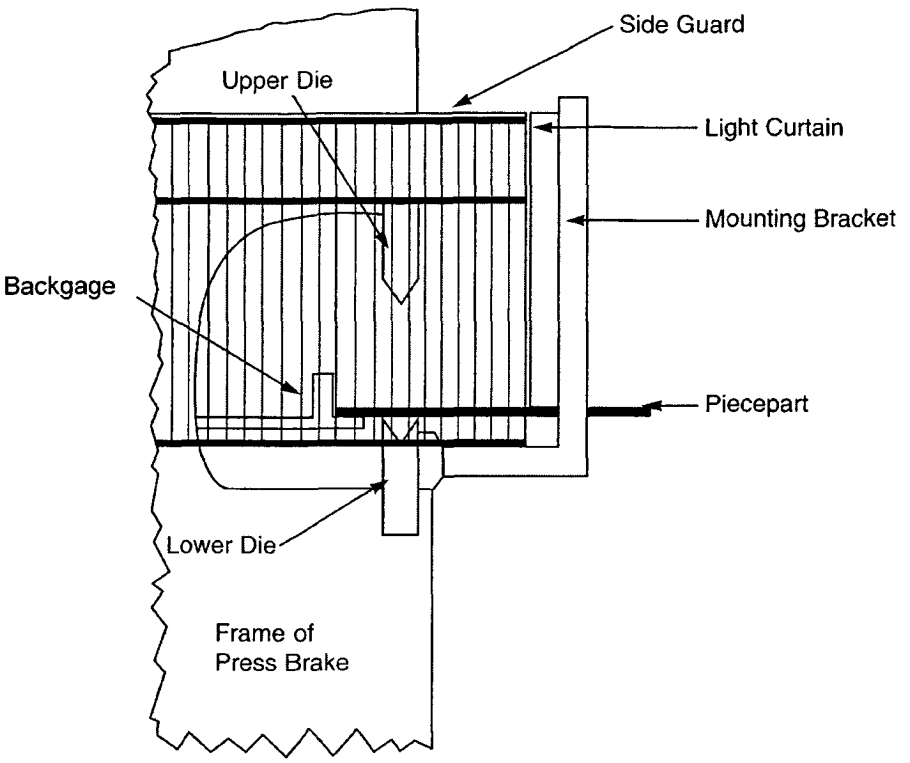


Figure 17
Typical Guards on Sides of Point of Operation

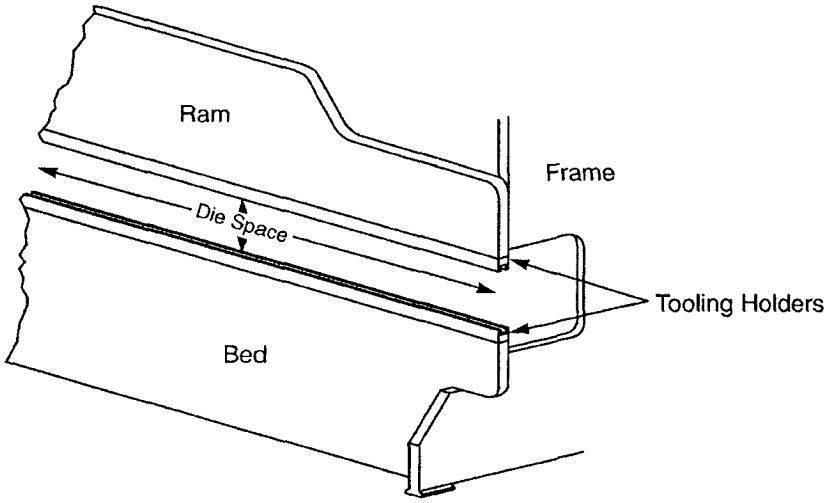


Figure 18
Example of Die Space

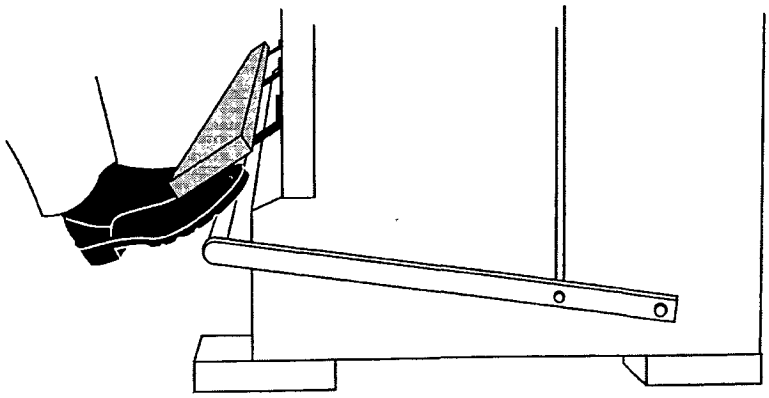


Figure 19
Example of Foot Treadle with Guard

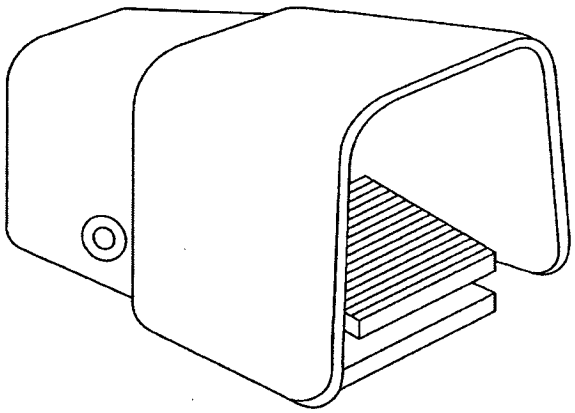


Figure 20
Example of Foot control

Annex B - Task / Hazard Identification
(Informative)

The sources of hazards listed below are the hazards associated with the design and construction, installation, use and care of the press brake.

B.1 Sources of hazards associated with the design and construction of a press brakes and powered folding machines include, but are not limited to:

a) power transmission hazards (rotating components, in-running nip points, pinch points between moving and stationary machine components) (8.1);
b) breakage or loosening of fasteners (6.6.2.1);
c) breakage or falling of machine components (6.6.2.1);
d) bursting of hydraulic/pneumatic piping, fittings, components from excessive pressure or temperature (6.6.2.1 and 6.14.9);
e) sudden release of stored energy (8.2);
f) failure of safety-related components, subassemblies or modules (Annex C);
g) loss of, or disturbance of power source(s) (6.1.1);
h) electrical interferences: (ANSI B11.TR3):
   - electromagnetic emissions and immunity;
   - electrostatic discharge.
i) mechanical interferences: (ANSI B11.TR3):
   - vibration;
   - shock;
   - impact loads.
j) human factors: (ANSI B11.TR3):
   - bed height;
   - location of controls;
   - lighting (illumination of dark or recessed machine areas);
   - noise (hearing loss);
   - accessibility and space limitations.

B.2 Sources of hazards associated with the installation of the press brake include, but are not limited to:

a) rigging practice (E7.3.1);
b) hazardous motion prior to the installation of operational (7.4.3):
   - guards and covers (power transmission);
   - safeguarding.
c) improper foundation (7.2.2);
d) hazards associated with the work area (7.2.1);
e) failure to control hazardous energy sources while installation activities are in progress (7.3.2);
f) work surfaces (7.2.1);
g) housekeeping practices (7.2.1);
h) accessibility or space limitations (7.2.1);
i) pinch, shear or crush points (8.1);
j) improper selection and connection of power sources (6.1; 7.1);
k) unexpected machine motion (7.3.3 & 7.4.1);
l) electrical shock (7.1);
m) mechanical shock and vibration (6.1.6 & 7.2.3);
n) environmental factors (7.3.1):
   - noise (ability to communicate);
   - lighting. (7.3.3).
o) process factors (7.1 & 7.4.1):
   - temperature;
   - liquids (over-spray or spillage);
   - contaminated air;
   - contaminated fluids.
p) hazards associated with the validation process (7.4);
q) human factors (ANSI B11.TR3).

B.3 Sources of hazards associated with the use of a press brake production system include, but are not limited to:

a) point of operation hazards (8);
b) failure to observe proper lockout/tagout procedures or other safe work procedures (7, 8 & 9);
c) handling and use of tooling (9);
d) handling of material (9);
e) exceeding the rated machine capacity (9);
f) use of the machine or tooling for other than its intended purposes (ANSI B11.TR3);
g) environmental factors (ANSI B11.TR3):
    - noise (hearing loss and ability to communicate);
    - leaks, spills;
    - lighting.
h) accessibility or space limitations (9.3.3);
i) housekeeping practices (9.3.3);
j) die setting procedures (9.1.3.2);
k) stored energy (9.1.5);
l) automatic backgages (8.8);
m) opening cycle hazards between machine components or material (8.4.1);
n) improper set-up and adjustment of the safeguarding (8 & 9);
o) pinch, shear or crush points between the safeguarding and the machine (8.4.2);
p) hazards associated with material during forming or bending, such as whipping of material or pinch points created between the material and parts of the machine or workholding devices (8.8 & 9.2.1);
q) human factors (9.2.1 & ANSI B11.TR3)

B.4 Sources of hazards associated with the care of a press brake production system include, but are not limited to:

a) failure to observe proper lockout/tagout procedures or other safe work procedures (9.3.2);
b) work area hazards, including housekeeping practices and work surfaces (9.3.3);
c) maintenance activities that necessitate the removal of guards, covers or point of operation safeguarding (9);
d) hazardous motion prior to the reinstallation of guards, covers or point of operation safeguarding (9);
e) work area clearance (9.3.3);
f) environmental factors (ANSI B11.TR3):
    - noise (ability to communicate);
    - lighting.
g) auxiliary equipment, such as backgages (8.8).

Annex C - Performance of the safety-related function(s)
(Informative)

The purpose of the requirements of this standard is to prevent exposure to hazardous motion (or situations). The level of performance of the safety-related function(s) depends on the level of risk associated with the hazard (see clause 5). There are various design strategies that may be used to ensure that failures of components, modules, devices or systems meet the level of performance required above.

Some design strategies may allow an accumulation of single failure and yet still stop (or prevent the re-initiation of) hazardous motion (or situations) when the next critical failure would cause loss of the safety-related function. Other strategies include self-diagnosis to determine and respond to failures. Still other strategies use tried and proven components and design principles to reduce the probability of a failure to a tolerable risk. Control reliability is a design strategy, method or feature that separates the safety-related functions of a system into components, modules, devices or systems that can be monitored or checked by other components, modules, devices or systems. It is axiomatic that protection from the loss of safety-related functions due to multiple, simultaneous failures (common cause) of components, sometimes referred to as "fail-safe", is not practically achievable. Catastrophic failure of the machine actuator (electrical, mechanical or fluidic), may result in the loss of the safety-related function. The use of redundant components, modules, devices or systems (with or without monitoring or checking) is frequently used in process control systems where the goal is to maintain the process in the event of a failure. Aircraft systems, chemical processing plants and electrical power transmission systems are examples of applications where the process must continue in the presence of a failure.

Control reliability is not provided by simple redundancy. There must be monitoring to assure that redundancy is maintained. Control reliability uses monitoring and checking to determine that a discernable component, module, device or system has failed and that the hazardous motion (or situation) is stopped, or prevented from starting or restarting. Control reliability ensures that a failure of the control system or device will not result in the loss of the safety-related function(s).

NOTE - Because some failures cannot be detected until the completion of a cycle or a portion of the cycle, loss of safety-related functions may occur for a portion of the machine cycle.

Control reliability of electrical, electronic, pneumatic, or hydraulic systems or devices frequently consists of monitored, multiple and independent parallel or series components, modules, devices or systems. Control reliability of machine control systems or devices can be achieved by the use of, but not limited to, one or both of the following:

- The use of two or more dissimilar components, modules, devices or systems, with the proper operation of each being verified (monitored) by the other(s) to ensure the performance of the safety function(s).
- The use of two or more identical components, modules, devices or systems, with the proper operation of each being verified (monitored) by the other(s) to ensure the performance of the safety function(s).

These methods require that the safeguarding device, its interface to the control system (or directly to the actuator control) and actuator control meet the above requirements.

Another control reliability strategy may be used when the machine motion is stopped and reinitiated at least once per cycle. This strategy requires that the control system and the actuator control utilize the design methods above. The safeguarding device and its interface may or may not be control reliable. To ensure that these elements cannot cause a loss of the safety-related function(s), the control system must be designed to require that the device and its interface is exercised automatically or by the operator (e.g., releasing hand controls or interrupting an electro-optical device) before a subsequent machine cycle may be initiated.

NOTE – The requirements of control reliability are not comparable to the requirements of ISO 13849-1, and exceed the requirements of category 2.

The achievement of control reliability is dependent upon the selection and integration of components, modules, devices and systems that have been specifically designed and intended for use in safety-related functions. A disciplined design process, including design guidelines, peer review and other elements, is important for achieving completeness and accuracy of the design, and should be implemented to ensure that control reliability is achieved.

Annex D - Safety Distance
(Informative)

The safeguarding devices listed below do not prevent an individual from reaching into a hazard area. In order for these devices to be effective, they must either prevent the start of, or stop hazardous motion (or situation) when an individual is exposed to the hazard. For the devices to accomplish this requirement, they must be located at a distance from the hazard such that hazardous motion (or situation) is prevented, completed or stopped before the individual can be harmed.

Devices that require location at a safety distance include, but are not limited to:

1) interlocked barrier guards;
2) two-hand control devices;
3) two-hand trip devices;
4) single control safeguarding devices;
5) electro-optical presence-sensing devices;
6) RF presence-sensing devices;
7) safety mat devices;
8) safety edge devices.

The first four devices protect individuals by positioning the individual at or beyond the safety distance before hazardous motion can be initiated, or by maintaining the individual's position at the safety distance after hazardous motion has been initiated. The remaining four devices protect individuals by detecting an individual entering (or their presence within) a hazard area at or within the safety distance.

NOTE - Barrier guards and movable barrier devices with various openings are located at a position from the hazard area based on the ability of the operator to reach through the opening. Figure D.10 (and Table D.1) is one method that may be used to locate barrier guards.

The safety distance may be calculated using the following equation:

$$Ds = K(T) \qquad \text{Equation (1)}$$

Where: Ds = the safety distance

K = the maximum speed that an individual can approach the hazard

T = the total time to stop hazardous motion which includes various factors as described below

The factor K is the speed constant and includes hand and body movements of an individual approaching a hazard area. The following factors should be considered when determining K:

a) Hand and arm movement;
b) Twisting of the body or shoulder, or bending at the waist;
c) Walking or running.

One of the accepted values for K is the hand speed constant (it is usually considered as the horizontal motion of the hand and arm while seated). Its common value is 1.6 m/s (63 in/s) although other values (typically greater) are also used. The hand speed constant does not include other body movements, which can affect the actual approach speed. Consideration of the above factors should be included when determining the speed constant for a given application.

The factor T is the total time that it takes for the hazardous motion to stop, or for the hazardous portion of the machine cycle to be completed. A power press may present a hazard during the closing portion of its cycle or a machining center may present a hazard during a tool change or while the tool is approaching the workpiece (trapping zone), but not present a hazard during the balance of the machine cycle.

T includes portions of time that vary by machine type and by the safeguarding device applied. The following affect the total stopping time:

a) Type of actuator;
   i. Full revolution clutch, or machines that cannot be stopped during a machine cycle. See note 1.
   ii. Part revolution friction clutch, or machines that can be stopped at any point in the machine cycle or anywhere during the hazardous portion of the machine cycle. See note 2.
   iii. Braking mechanism. See note 3.
   iv. Stopping capability of the motors and drive. See note 4.
   v. Reaction time of valves. See note 5.
b) Reaction time of the machine control system. See note 6.
c) Reaction time of the safeguarding device, including its interface. See note 7.
d) Additional time required by the use of braking performance monitor. See note 8.

Note 1: Full revolution (pin) clutches have one or more engaging points within a rotation of the flywheel where the clutch can be engaged. Once engaged, the clutch completes a full revolution or cycle (stroke) before it is disengaged and brought to a stop. After the machine is tripped by the control system or mechanical treadle, pedal, hand controls or levers, the clutch typically engages after the flywheel rotates to the engaging position. Therefore, the possibility exists that the tripping device could have tripped the clutch just after the flywheel engaging point has passed and will not engage the clutch until the flywheel has rotated one full revolution. Assuming that the hazard exists during the closing portion of the cycle or stroke (provided that no hazards are generated during the opening portion), the time to stop hazardous motion could take up to one and a half times the time it takes the machine to complete one cycle (stroke). For clutches with only one engaging point the stopping time, Ts, is:

$$Ts = 1.5(Tmc) \quad \text{Equation (2)}$$

Where: Tmc = the time it takes to complete a machine cycle (stroke)

Some clutches have multiple engaging points on the flywheel. Therefore, the clutch has more than one position where engagement can occur. The equation for calculation of this time, the stopping time Ts is:

$$Ts = (1/2 + 1/N)(Tmc) \quad \text{Equation (3)}$$

Where: N = the number of engaging points on the flywheel

For machines that are tripped (or sequenced) to initiate the machine cycle, which in turn initiates immediate motion and which cannot be stopped until the completion of the machine cycle, the stopping time Ts is:

$$Ts = Thm \quad \text{Equation (4)}$$

Where: Thm = the time, after initiation of motion, until hazardous motion is completed

Note 2: The stopping time, Ts, of part revolution clutch driven machines or machines that can be stopped at any point in the machine cycle or stopped anywhere during the hazardous portion of the machine cycle is equal to the time it takes to stop hazardous motion (see also, Note 3). If eddy current or other electro-magnetic clutches are used, see Note 4.

Note 3: The stopping time, Ts, is the time it takes to disengage the clutch, the time it takes to apply the brake and the time it takes the brake to stop motion.

Note 4: The stopping time, Ts, for direct drive, motor driven machines utilizing full voltage motors, servo systems, vector systems or other variable speed systems, is equal to the time it takes to stop hazardous motion after a stop command or signal is given to the motor contactor or drive system. This time should take into consideration both uncontrolled stops (category 0) and controlled stops (categories 1 and 2) including dynamic braking. See ANSI / NFPA 79.

Note 5: The stopping time, Ts, of machines actuated or controlled by pneumatic or hydraulic valves must include the reaction time of the valve measured from the time that the valve is de-energized until motion is stopped. Stopping time for systems using valves may be affected by high or low supply pressures, exhaust restrictions, sluggish spools or poppets or performance of the pilot sections.

Note 6: Control systems inherently have a delay from the time its inputs or the system logic initiate a stop command, until the system's output de-energizes the actuator. This time, Tc, is the reaction time of the control system.

Note 7: Safeguarding devices also have a delay from the time that they sense the presence, or absence (for hand controls and trips or hostage controls) of individuals. Additionally, there may be a delay caused by the interface between the device and the control system. The interface may, as an example, include interposing relays. The interface delay must be added to the total delay time. This time, Tr, is the reaction time of the device and its interface. The reaction time of the device, without the interface, is stated by the device manufacturer.

Note 8: Stopping performance monitors are used to assure that a gradual increase in the stopping time caused by the degradation of components does not exceed the stopping time used to calculate the safety distance for the safeguarding device. Stopping time at the end of a machine cycle is usually different than the stopping time during the hazardous portion(s) of the cycle, and since these times may vary due to such factors as machine temperature, tool loading and energy transferred to the workpiece, a factor, $Tspm$, must be added to the total stopping time.

$Tspm$ is a calculated factor. As an example, if the monitor is set to a point or time 5% greater than the normal stopping position or time, then $Tspm$ is equal to 5% of T_s.

Therefore, the total stopping time is the sum of these factors and may be represented by the following equation:

$$T = Ts + Tc + Tr + Tspm \quad \text{Equation (5)}$$

Stop time measuring devices are normally used to measure these times. When using these devices, Ts can be measured from the output of the control system until motion is stopped. Likewise, $Ts + Tc$ can be measured from the input to the control system. Some stop time measuring devices include plungers and flags that are used to simulate operation by an individual. When using this type of device, it is possible to measure $Ts + Tc + Tr$. (Use the manufacturer's value for T_r, when provided).

Substituting $Ts + Tc + Tr + Tspm$ for T in Equation 1, the equation for calculating the safety distance becomes:

$$Ds = K(Ts + Tc + Tr + Tspm) \quad \text{Equation (6)}$$

An additional distance needs to be added to the safety distance when using electro-optical devices, safety mats, single control safety devices and RF devices.

Electro-optical and RF devices do not detect the presence of individuals at the plane or within the field of the device until an amount of penetration into the plane or field occurs. This amount is known as the distance (depth) penetration factor. The distance that must be added is called Dpf. See Figures D.1 through D.6 and D.9.

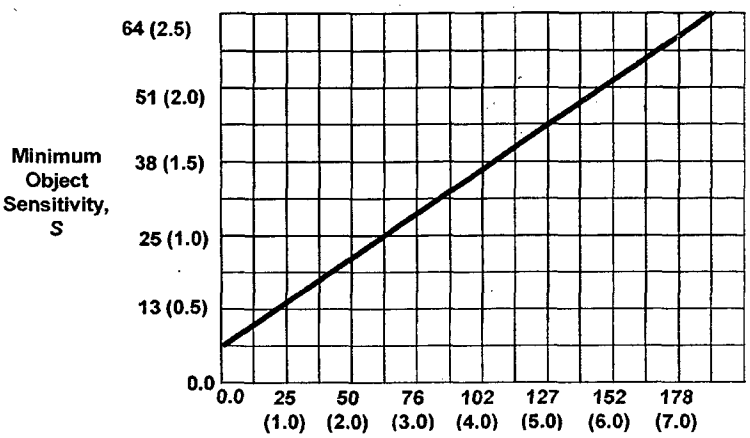
When using safety mats and single control safety devices, the possibility exists for the individual to be reaching into the hazardous area or stepping onto the mat beyond its edge. The amount of reach or stride should be added to the safety distance and can be called Dpf. See Figures D.2, D.6 and D.8.

The equation for calculating the safety distance for these devices, therefore, is:

$$Ds = K(Ts + Tc + Tr + Tspm) + Dpf \quad \text{Equation (7)}$$

Equation 7 can be used to calculate the safety distance for the eight safeguarding devices listed in paragraph 2 by substituting the non-zero values or combination of values as determined above.

Figure D.1: Penetration factor, *Dpf*, for presence sensing devices used in a vertical application with object sensitivity less than 64 mm (2.5 inches)



Dpf = 3.4 (*S* – 7) mm
(*Dpf* = 3.4 (*S* – 0.275) in

(*Dpf*), the distance added to the safety distance due to the penetration factor compensates for varying object sensitivities of electro-optical presence sensing devices.

When blanking features are used and when the blanked area is not completely filled by the workpiece or part, or by mechanical guarding, the minimum object sensitivity can be calculated as:

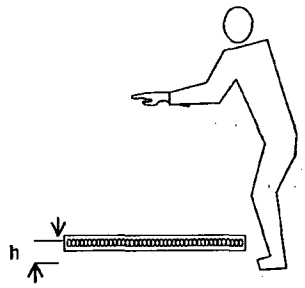
Object sensitivity = size of the blanked area plus minimum object sensitivity without blanking.

Once this value is found, then determine *Dpf*.

If the entire blanked area is filled with mechanical guarding or other fixed material or guards, use the device's object sensitivity to determine *Dpf*.

Figure D.2: Dpf for ground level devices that can be reached over (30° or less)

Examples include safety mats, area scanners, and horizontally mounted electro-optical devices.



REACH-OVER
Dpf = 1.2 m (48 in) for horizontal sensing field applications without vertical sensing.

Allowable Sensing Field Heights in mm. (*in*)

Objects Sensitivity (*S*)	Mounting Height (*h*) Minimum	Maximum
> 50 (2)	0	990 (39)
64 (2.5)	190 (7.5)	990 (39)
76 (3.0)	380 (15)	990 (39)
89 (3.5)	570(22.5)	990 (39)
102 (4.0)	760 (30)	990 (39)
108 (4.25)	860 (33.75)	990 (39)
117 (4.6)	990 (39)	990 (39)

Minimum mounting height (*h*) can also be determined by the following,
h = 15 (*S* – 50) mm
h = 15 (*S* – 2) in
where *S* is the object sensitivity.

NOTE - Minimum depth-of-field or sensing area must hinder an individual from stepping over the electro-optical presence-sensing device or safety mat. This distance is 1.2 m (4 ft) if an individual can step over and pass unrestricted; 900 mm (3 ft) if supplemental safeguarding or physical barriers are used such that an individual must stand within the sensing area. For electro-optical presence sensing devices inclined greater than 30° from horizontal, and for which you can reach over without being detected, use Figure D.1.

Figure D.3: *Dpf* for object sensitivities greater than 64mm (2.5 inches)

NOTE - For electro-optical presence sensing devices using large blanked areas, or if an individual can otherwise reach through or over the sensing field and not be detected, the distance between any two adjacent detection points shall not be greater than 600 mm (24 in), i.e., from one active point to the next active point above.

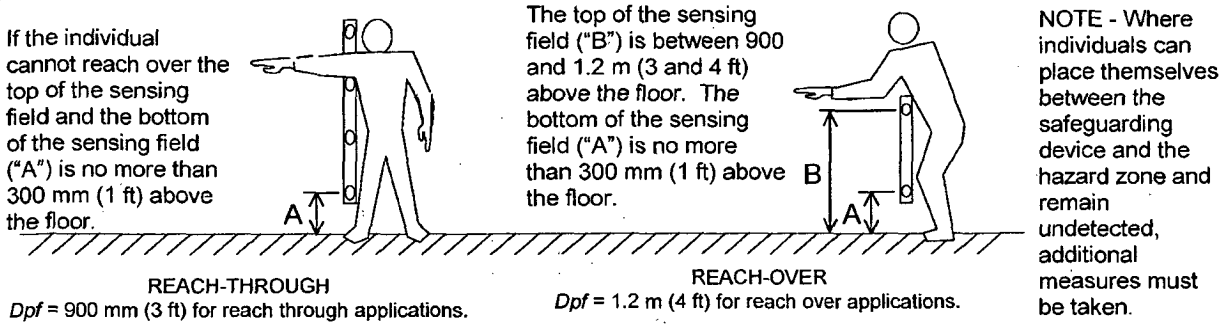
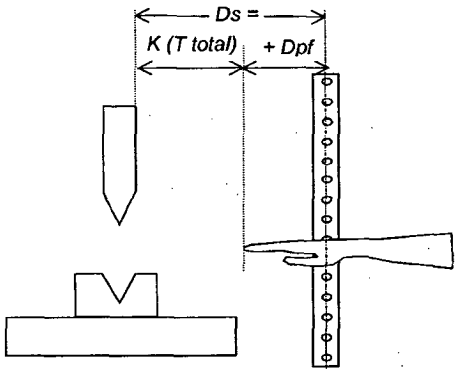


Figure D.4: Example of guarding with object sensitivity less than 64 mm (2.5 inches)



NOTE - Where individuals can place themselves between the safeguarding device and the hazard zone and remain undetected, additional measures must be taken.

Figure D.5: Example of guarding with various object sensitivities

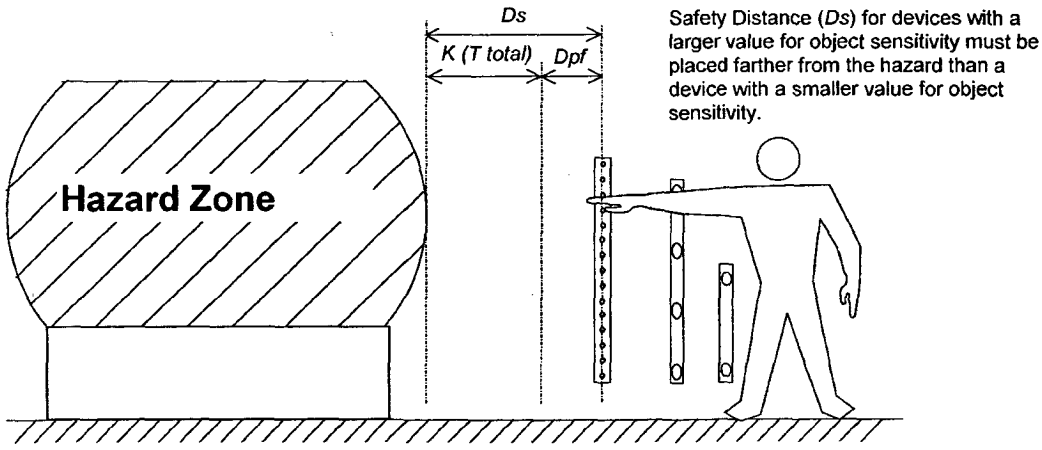
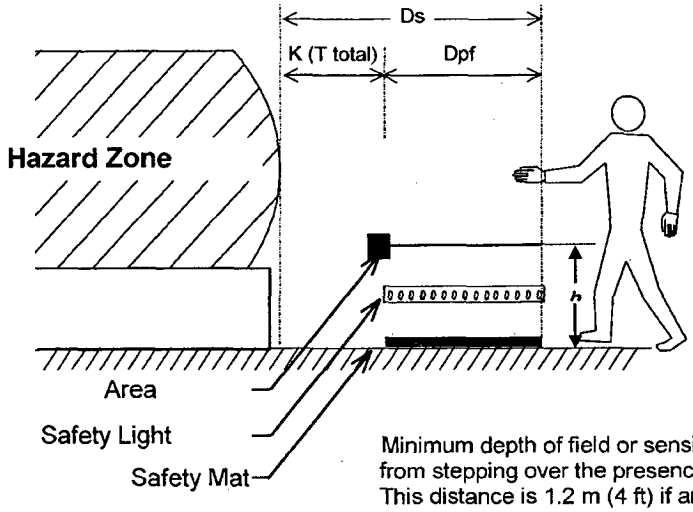


Figure D.6: *Dpf* for ground level devices that can be reached over (≤ 30°)



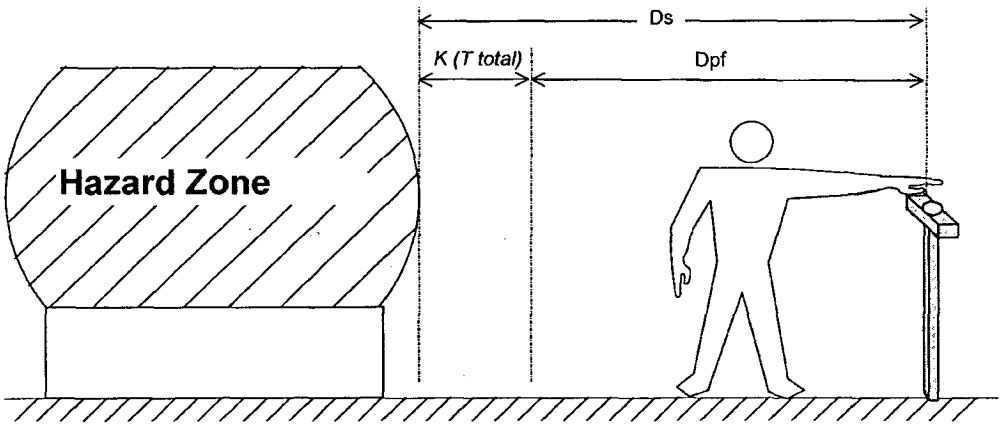
Allowable Sensing Field Heights in mm (in)

Objects Sensitivity	Mounting Height (*h*)	
	Minimum	Maximum
< 50 (2)	**0**	**990 (39)**
64 (2.5))	**190 (7.5)**	**990 (39)**
76 (3.0)	**380 (15)**	**990 (39)**
89 (3.5)	**570 (22.5)**	**990 (39)**
102 (4.0)	**760 (30)**	**990 (39)**
108 (4.25)	**860 (33.75)**	**990 (39)**
117 (4.6)	**990 (39)**	**990 (39)**

Minimum mounting height (h) can also be determined by the following,
h = 15 (S – 50) mm
h = 15 (S – 2) in
where S is the object sensitivity.

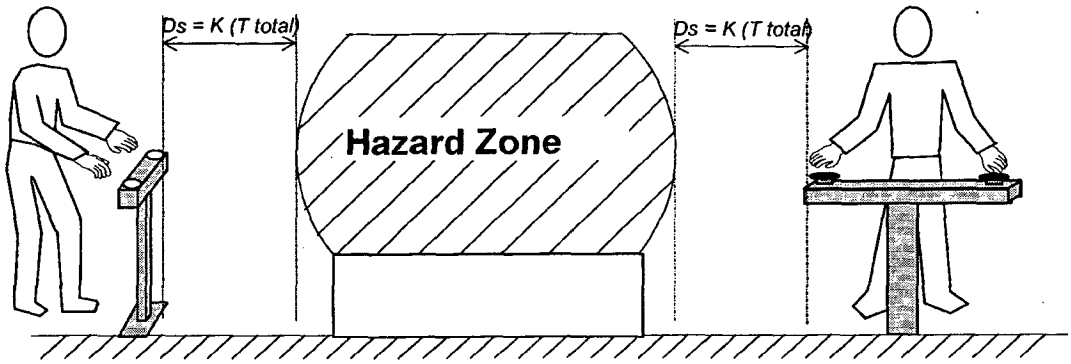
Minimum depth of field or sensing area must hinder an individual from stepping over the presence-sensing device or safety mat. This distance is 1.2 m (4 ft) if an individual can step over and pass unrestricted, 900 mm (3 ft) if supplemental safeguarding or physical barriers are used such that an individual must stand within the sensing area.

Figure D.7: Single Control Device



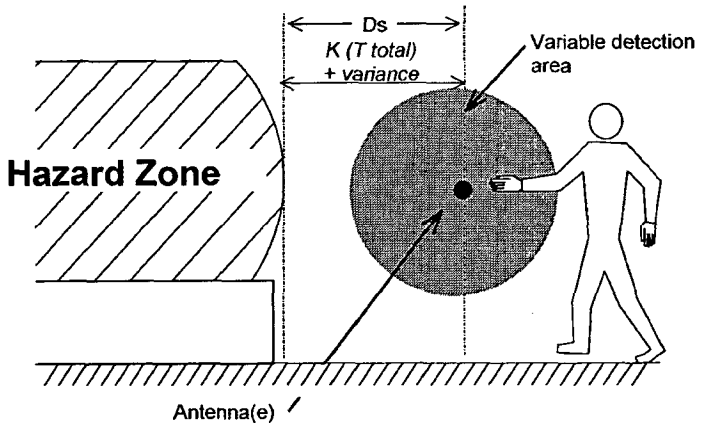
Safety Distance (*Ds*) for a Single Control Device includes a large *Dpf* of 2 meters (6.5 feet) due to the ability of the operator to stand between the device and reach towards the hazard.

Figure D.8: Two-hand Control & Two-Hand Trip Devices



Safety Distance (*Ds*) for Two-Hand Control and Two-Hand Trip applications have a *Dpf* = 0. When used as a safeguarding device, the position must be placed such that the safety distance is measured from the closest hand control to the hazard.

Figure D.9: RF Presence Sensing Devices



The point of detection must take into account fluctuations and variances in the field density and sensitivity due to environmental conditions and physical changes in the work area. This amount must be added to *K(T total)* to determine the total safety distance, *Ds*.

Figure D.10: Location of Guards vs. Openings

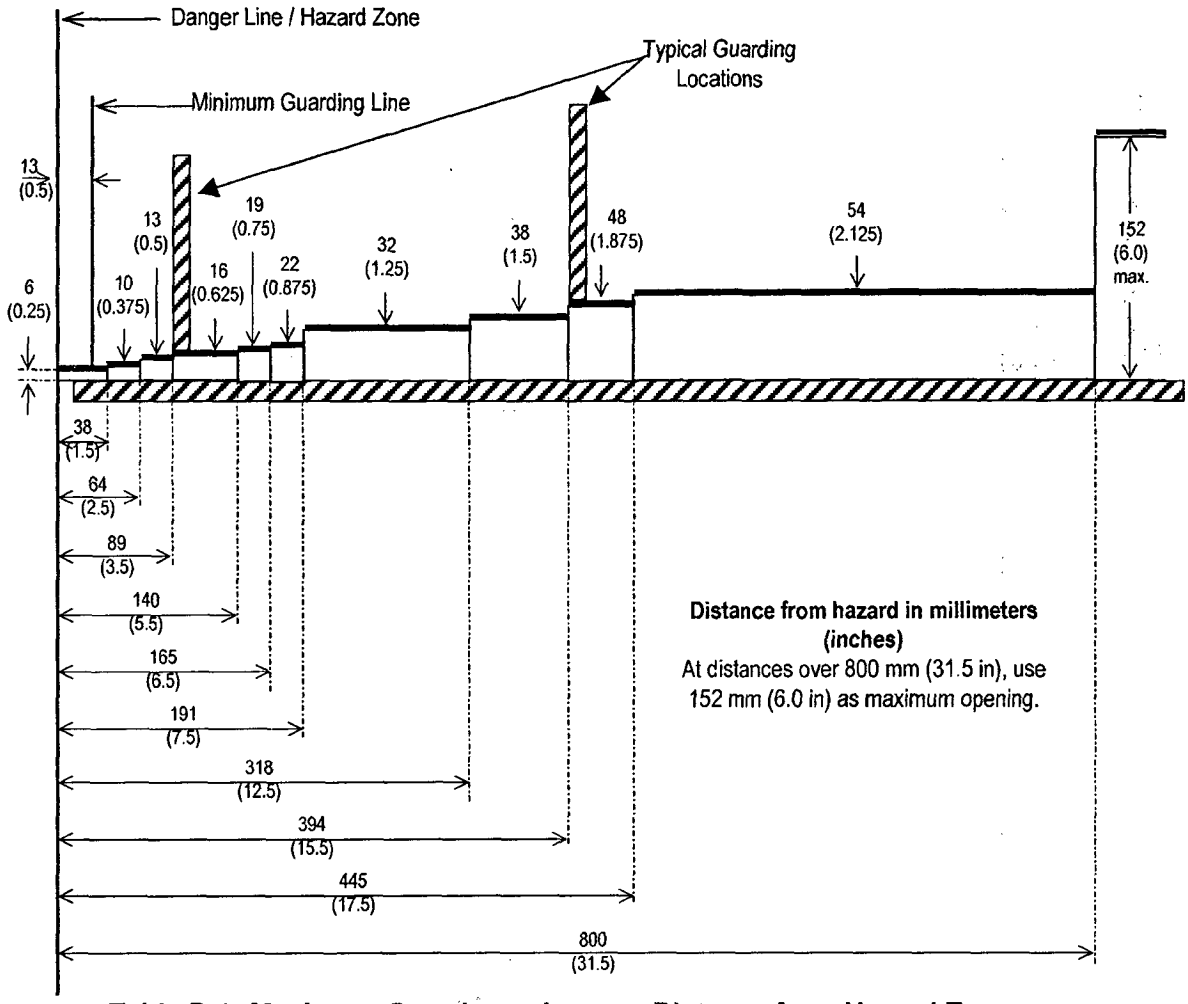
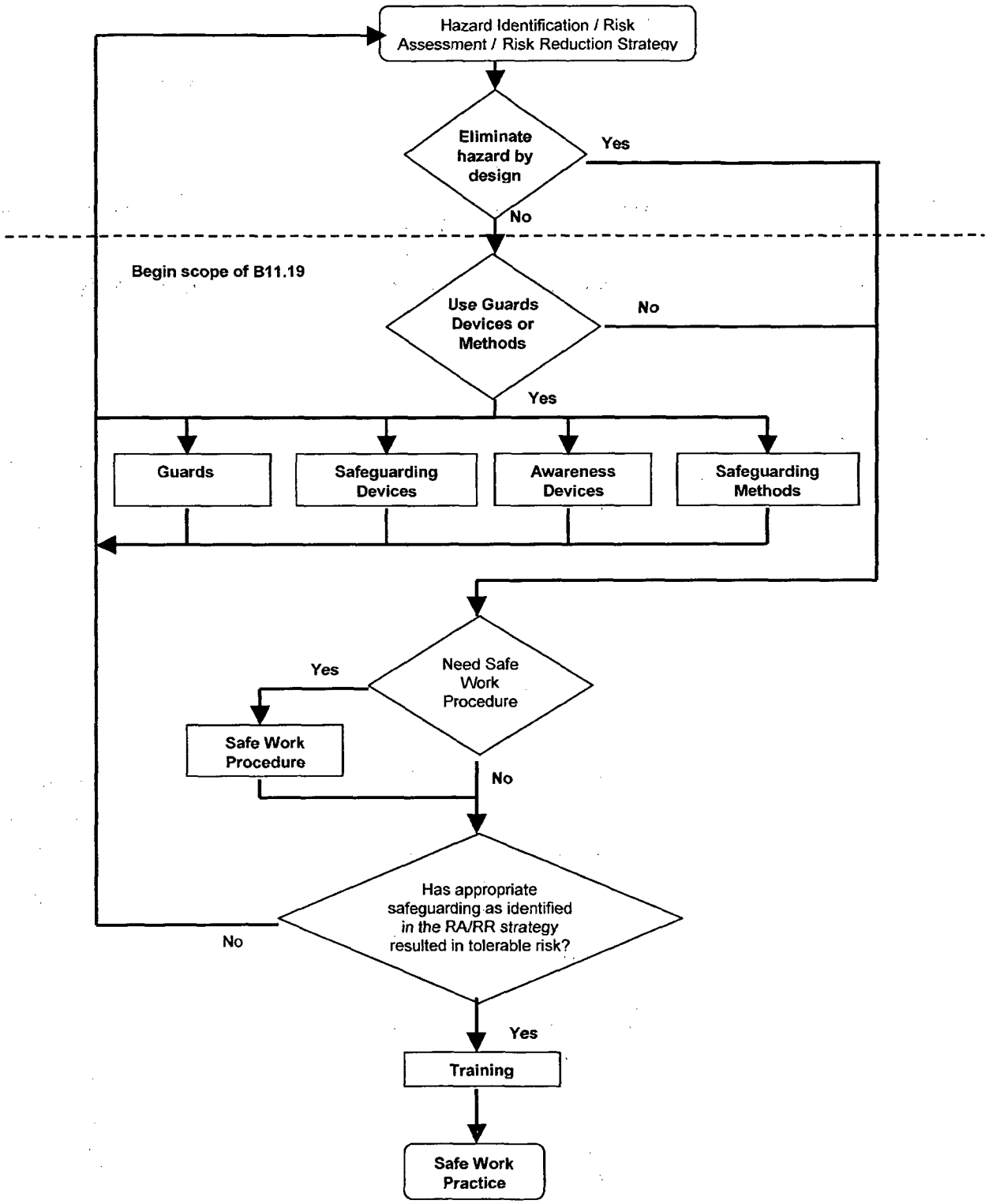


Table D.1: Maximum Guard openings vs. Distance from Hazard Zone

Distance of Opening from Hazard Zone (millimeters)	*Maximum Width of Opening (mm)*	*Distance of Opening from Hazard Zone (inches)*	*Maximum Width of Opening (in)*
13 to 38	6	0.5 to 1.5	0.25
Over 38 to 64	10	Over 1.5 to 2.5	0.375
Over 64 to 89	13	Over 2.5 to 3.5	0.5
Over 89 to 140	16	Over 3.5 to 5.5	0.625
Over 140 to 165	19	Over 5.5 to 6.5	0.75
Over 165 to 191	22	Over 6.5 to 7.5	0.875
Over 191 to 318	32	Over 7.5 to 12.5	1.25
Over 318 to 394	38	Over 12.5 to 15.5	1.5
Over 394 to 445	48	Over 15.5 to 17.5	1.875
Over 445 to 800	54	Over 17.5 to 31.5	2.125

NOTE – At distances over 800 mm (31.5 inches), use 152 mm (6.0 in) as maximum opening

Annex E - Safeguarding Flowchart
(Informative)



Annex F - Checklist
(Informative)

The following is intended as a guide for the user to develop a checklist / inspection list for their specific press brake production system. It is not intended to be inclusive of all items. The frequency of inspection is dependent on the usage of the machine. The user should determine who is responsible for performing the specific task. See the press brake supplier's or ancillary equipment supplier's guidelines for specific requirements.

Refer to the appropriate clauses of this standard for further information.

NOTE – The purpose of this checklist is to provide a quick review and reference of ANSI B11.3 standard; this checklist in no way replaces the standard or reduces the responsibility of the individual to fully understand and comply with its requirements.

Items recommended to be checked on a daily basis include but are not limited to:

- housekeeping in vicinity of machine;
- point of operation safeguarding for proper function, adjustment and location;
- auxiliary safeguarding for proper function adjustment and location;
- material position gage;
- proper placement for all guards and covers;
- loose components;
- air and oil leaks;
- operator controls for proper mode selection, cycle the press brake and observe for normal operation.

Other items to consider checking include but are not limited to the following (refer to supplier's guidelines for additional items and recommended inspection frequency):

- oil levels;
- air and oil filters
- concealed areas for cracked lines, loose components, etc.;
- for proper stopping point or stopping capability;
- drive train system components or actuators;
- press brake floor mounting hardware for cracks or loose components;
- renewable components for wear (consult supplier's guidelines for frequency);
- and replace lubricants and fluids per supplier's recommendations.

NOTES

AMT

The Association For Manufacturing Technology

100 Years of Building Global Productivity

7901 Westpark Drive, McLean, Virginia 22102-4206